June 9, 1964 D. H. ELLIS 3,135,991

DOOR CLOSER MECHANISM

Original Filed Dec. 19, 1958 2 Sheets-Sheet 1

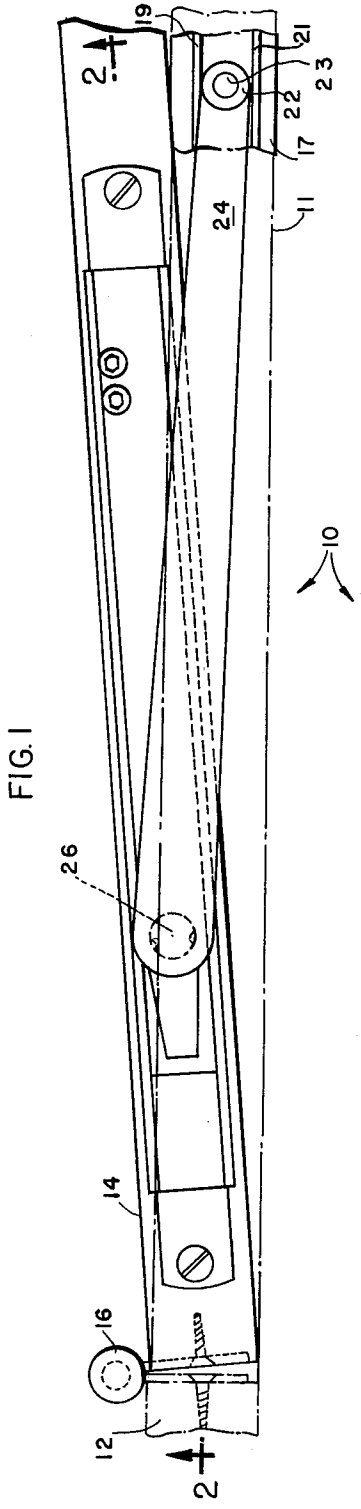


FIG. 1

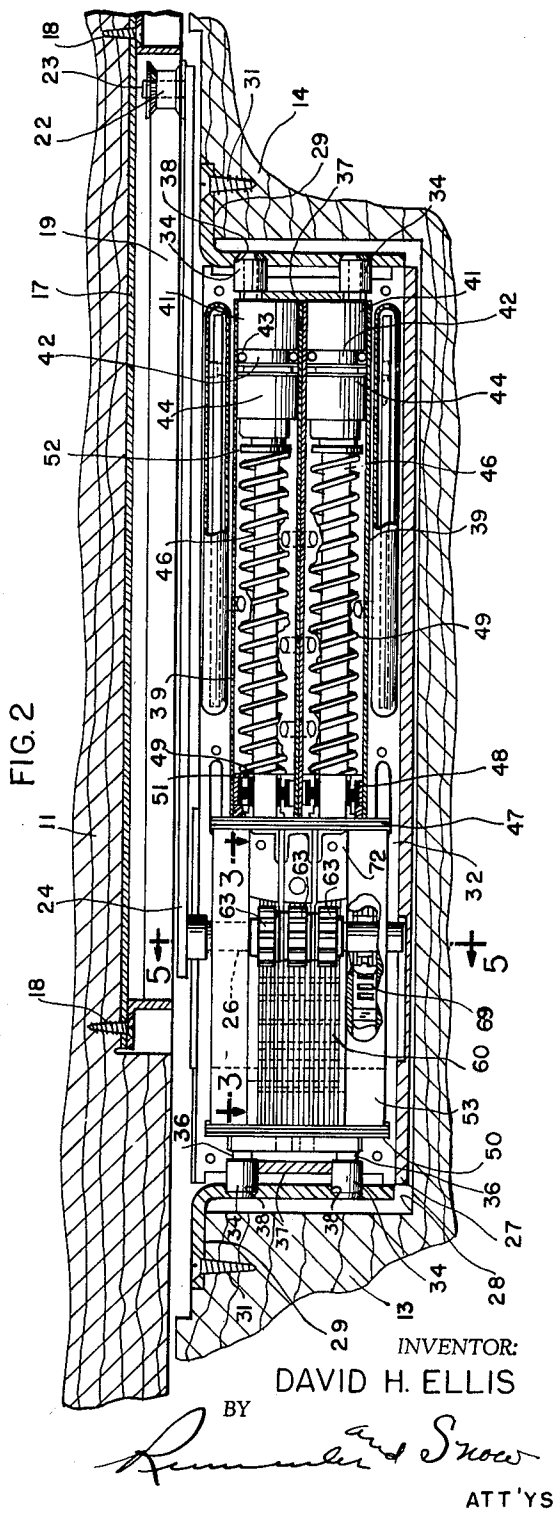


FIG. 2

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FIG. 3

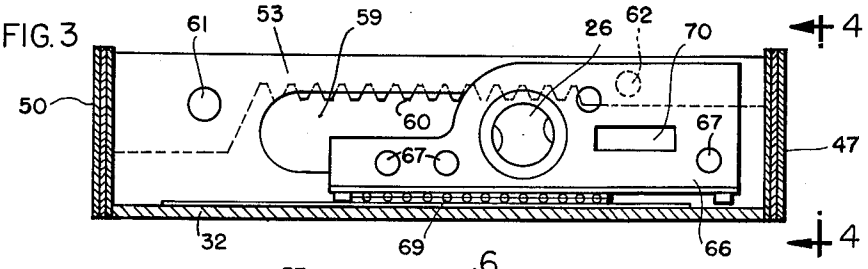


FIG. 5

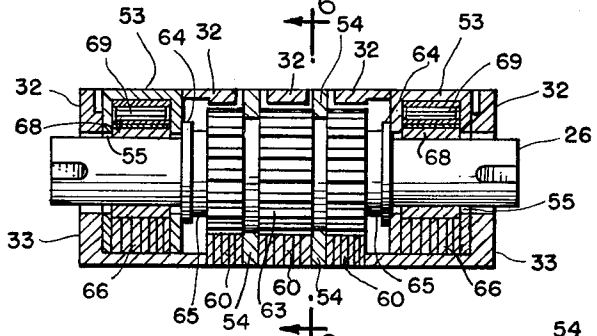


FIG. 6

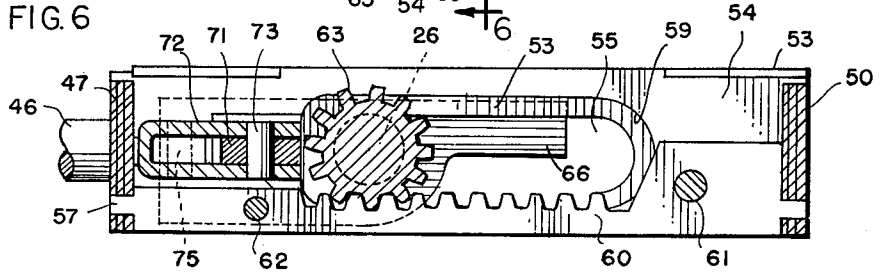


FIG. 4

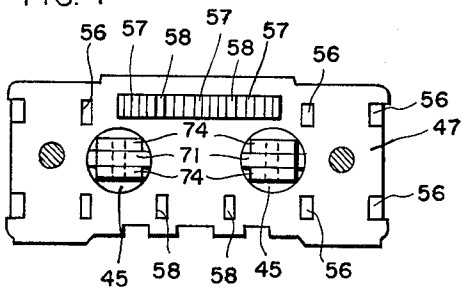
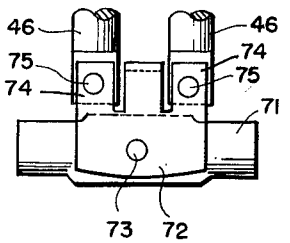


FIG. 7



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DOOR CLOSER MECHANISM

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Original application Dec. 19, 1958, Ser. No. 781,565, now Patent No. 3,040,372, dated June 26, 1962. Divided and this application June 14, 1962, Ser. No. 202,446
9 Claims. (Cl. 16—62)

This invention relates to door checks and closers of the single-arm type which may be either mortised into or surface mounted on the upper portion of a door, and which are adapted to be connected to a doorway head jamb by an operating arm arranged to slide in a guide rail on the head jamb to operate the closer mechanism for storing energy upon door opening movement and subsequently utilizing the stored energy for automatic door closing movement.

This application is a division of my co-pending application, Serial No. 781,565, filed December 19, 1958, now Patent No. 3,040,372, issued June 26, 1962 for Door Closer Mechanism.

One of the principal objects of the invention is to provide a door closer mechanism which can be completely housed within the head jamb portion of a door casing and within the top rail or edge of a door, the mechanism being characterized by a single arm having translative movement in the door jamb and secured at its other end to a spindle mounted gear rotating translatively with respect to a rack concealed within the door rail, the said spindle being connected to an energy storing device for door return or closing movement.

Another object is to provide a door closer mechanism having an improved mechanical unit construction for operative connection with an enclosed hydraulically controlled energy storing device for door closing operation.

Yet another object is to provide a door closer mechanism of the aforesaid single-arm type wherein force translation is accomplished by an improved traveling spindle mechanism.

Still further objects are to provide a traveling spindle mounted gear and rack structure characterized by the rack being formed in or as part of a lamina structure comprised of punched, rather than milled, laminations; to provide a bearing and rack structure for a carriage mounted spindle, both the rack and carriage being made from laminar elements which are simple to fabricate and assemble; and to provide an improved sub-assembly construction embodying a traveling spindle mechanism for use in door closer mechanisms.

A specific embodiment of this invention is shown in the accompanying drawings in which:

FIGURE 1 is a top plan view, partly fragmentary, of a preferred form of the invention shown mortised in the top edge portion of a door;

FIG. 2 is a view, partly in section, taken substanitally on the plane of line 2—2 of FIG. 1 the near frame member being removed to show the mechanism;

FIG. 3 is a detail sectional view of the traveling spindle assembly, taken substantially on the plane of the line 3—3 of FIG. 2, showing the form of the spindle carriage and its bearing support;

FIG. 4 is an end view of the traveling spindle assembly looking in the direction of the arrows 4—4 of FIG. 3;

FIG. 5 is a detail sectional view of the traveling spindle assembly, taken substantially along line 5—5 of FIG. 2;

FIG. 6 is a sectional view of the traveling spindle assembly taken on the plane of the line 6—6 of FIG. 5; and

FIG. 7 is a plan view showing details of the yoke for attachment of the traveling spindle to the energy storing device.

Referring now to the drawings, improved door closer mechanism according to the present invention is denoted by the reference numeral **10** and is shown situate in an upper jamb member **11** of a door frame **12** and an upper rail or edge **13** of a door **14** hung on butts **16**. The head jamb **11** is recessed to receive a guide rail frame **17** held therein by screws **18**; and frame **17** has a pair of spaced longitudinally extending guide rails **19** and **21**, for a roller **22** mounted on stub shaft **23** extending from an operating arm **24**. A spindle **26** is fast to the other end of the operating arm **24** and is adapted to have both rotative and translative movement within the closer mechanism upon opening movement of the door **14** to store energy which is controllably released for effecting the closing of the door **14**.

Spindle **26** is part of an operating sub-assembly connected to a separate mechanism for storing the energy for the closing or return movement of the door **14**, this combination comprising a door closer assembly housed within a casing **27** supported within a recess **28** in the door rail **13**. As shown, the casing **27** has flanges **29** held by screws **31** to the rail **13**.

The sub-assembly for supporting the spindle **26** is mounted between two frame members **32** and **33**, disposed in confronting relationship, see FIG. 5. These frame members are complementary halves of an inner housing for the closer mechanism and when bolted together, in face to face relation, provide a unitary assembly which in turn is held to the casing **27** by means of hollow liner pins **34** and screws **36** tapped into the end walls **37** of the frame members **32** and **33**, liner pins **34** being received in complementary holes **38** in the end walls of the casing **27**.

The housing formed by the two confronting frame members **32** and **33** is adapted to form a common support for separate mechanical and hydraulic sections of the closer mechanism and as shown the hydraulic section comprises a pair of side by side cylinders **39** each having a fixed cylinder head **41**. A groove **42** in each cylinder head **41** receives an O-ring seal **43**, to prevent the escape of fluid from the cylinder **39**. Each cylinder **39** is provided with a movable piston **44** which is secured to a respective piston rod **46**, each piston rod **46** extending from its cylinder and into an opening **45** in an end frame member **47** of the mechanical section which comprises the sub-assembly of the present invention. A suitable seal **48** is provided for each piston rod **46** as it leaves the respective cylinder **39**, and a compression spring **49** is constrained within each cylinder **39** between a thrust washer **51**, at the seal **48**, and a shoulder **52** formed on the piston rod **46** adjacent the piston **44**. Details of construction of the cylinders **39** and the piston and spring structure comprising the spring closing unit or hydraulic section of the closer are to be found in my aforementioned co-pending application.

As herein shown, the traveling spindle assembly of my present invention is comprised generally of a frame portion, a rack constituting part of the frame, the spindle **26** having a gear connection with the rack, two traveling carriage devices, and a yoke and clevis assembly for connecting the spindle assembly to the spring closing unit.

As shown in FIGURES 2 and 5 the frame portion of the traveling spindle assembly is comprised of two generally U-shaped side rails **53**, substantially identical end portions **47** and **50**, and longitudinal intermediate support members **54**. The U-shaped side rails **53** may be stamped out of metal and are provided with substantially identical openings **55** in each leg to accommodate the movement of the spindle and yoke as will be described. Each side rail has end lugs **56**, see FIGURE 4, two extending longitudinally from the ends of each leg for connection with the respective end portions **47** and **50**. The end portions

47 and 50 are each comprised of a plurality of laminations of identically shaped stamped pieces of metal, formed as shown in FIGURE 4, suitably punched to receive the securing lugs 56 from the side rails and similar lugs 57 and 58 from the rack and the transverse support members respectively. These lugs may be peened over the outer surfaces of the end portions 47 and 50 to provide a rigid unitary structure.

The support members 54 are also stamped out of metal and are formed with openings 59 to accommodate the movement of the spindle, yoke and clevis, these openings being similar in shape to those formed in the legs of the side rails 53 previously described.

The rack 60 is likewise formed of a plurality of laminations of identically shaped stamped pieces of metal which are securely held within the frame by means of the end lugs 57 extending through the end plates 47 and 50. The laminations are further secured together by a rivet member 61 which extends across the entire sub-assembly adjacent one end, including the side rails 53, and by rivet 62 which secures together the opposite ends of the rack laminations. As shown in FIGS. 4 and 5 the laminations comprising the rack 60 are arranged in three groups separated by the support members 54 and all are tied together in a unitary stack by the rivets 61 and 62.

The spindle 26 is combined with a gear 63 meshed with the rack 60 and arranged to travel therealong. The spindle is also fast to the gear 63 and hence is in driving relation with the rack so that rotation of the spindle will cause it to travel along the rack or, conversely, movement of the spindle lengthwise of the rack will cause it to rotate. In the form shown the gear 63 has three sections, one for each section of the rack 60, spaced by shoulders or collars to accommodate the support members 54. Also the spindle 26 extends beyond each of the side rails 53 of the sub-assembly frame and is restrained from axial movement by washers 64 located between the side rails and shoulders 65 on the gear.

The traveling carriage members 66 are best shown in FIGS. 3 and 5, and as shown are formed of a plurality of laminations of identically shaped stamped pieces of metal which may be held together in any conventional manner such as, for example, rivets 67. A circular opening in each carriage member, preferably lined with a bearing means, such as a roller or needle bearing 68, is provided for receiving the spindle 26 which rotates therein. A traveling carriage unit is located within each of the U-shaped rails 53 on either side of the sub-assembly frame, these rails being so shaped to act as guides for the movement of the carriages with the traveling spindle 26. In the preferred embodiment, a ladder type needle or roller bearing unit 69 is located between each of the carriages and the base portions of the U-shaped guide rails 53, on the side of the pinion gear 63 opposite the rack 60, to reduce the friction within the guide rails.

Each carriage member is further provided with an opening 70 for receiving the ends of a yoke bar 71 which is spaced from the gear and extends between the carriage members 66 for movement therewith. A clevis 72 is pivotally attached to the yoke bar 71 by a pin 73 and is formed with laterally disposed fingers 74 for pivotal attachment to the ends of the two connecting rods 46 by pins 75, as shown in FIG. 7, in order to compel movement of the pistons with the spindle when the spindle assembly is connected thereto as shown in FIG. 2.

The sub-assembly unit herein described comprises the "mechanical end" or power transmission portion of a door closer mechanism and combines a rack and pinion structure with a sliding pinion support means, on which the pinion spindle is journaled, in such a manner that the stationary elements when connected together across their ends constitute a frame or housing within which the movable elements operate and are retained. The structure of the unit is thus extremely simple and rugged and one which, aside from the pinion spindle and bearing, can be made entirely from simple metal stampings.

It will now be seen that with this improved "mechanical-end" sub-assembly, and because of its sealed-off relation with the "hydraulic-end" of the closer unit, the entire sub-assembly can be incorporated into the side wall of the closer mechanism housing so that the rack 60 can be substantially coincident with the wall and for practical purposes a part thereof, as shown in FIG. 5. This means that the rack will occupy a minimum of the space between the side walls 32—33 of the housing and a maximum of space will be available for the pinion gear 63 and the sliding carriages 66.

This factor is particularly important in a closer of the present type where, for power advantage, a maximum size of spindle gear is desired and yet the available space is so limited.

The details of the hydraulic and spring mechanism contained within the cylinders 39 are best shown in my co-pending application previously referred to, and the precise details of operation are not important herein except that it may be stated that when the door 14 is opened, as seen in FIG. 1, the roller 22 on the operating arm 24 is confined to slide between its guideways 19 and 21, thus causing swinging of the arm 24 and turning of the spindle 26. This turning of the spindle 26 causes the associated pinion 63 fast thereon to travel with respect with the racks 60, and to thereby cause the spindle and its carriages 66 to move to the left against the force of the springs 49 contained within the cylinders 39.

As disclosed in my aforementioned application, the cylinders 39 are filled with hydraulic fluid which is free to move past the pistons 44 during the door opening movement, the springs 49 storing energy for the return movement of the door 14 which is controlled in its closing movement by suitable valving mechanism controlling the return of the fluid to the piston rod side of piston 44.

The invention herein is directed to the provision of the structure comprising the traveling spindle moving on a fixed rack for achieving the storage and more efficient transmission of energy for the return or closing movement of the door, the spindle and its rack cooperating with a single door operating arm, which is movable along a guide rail in the head jamb and entirely concealed when door 14 is closed.

The invention herein also includes the provision of a laminar carriage structure for guiding the spindle in its movement on the rack and the rack is characterized by a similar laminar construction, the elements in each case being formed from simple stampings rather than by expensive milling operations.

Each of the carriage members 66 is also free to move along its respective guideway 53 without binding by reason of the ladder type needle bearing structure 69 on which the carriages slide, the bearing 69 being designed to absorb the thrust incident to the movement of the spindle upon rotating engagement of its pinion with the teeth of the rack 60.

The main advantages of this invention reside in the simple and low cost construction of the spindle assembly; in the fact that the improved spindle assembly can be prefabricated as a complete "mechanical end" unit for a door closer mechanism; and in the structural arrangement of the spindle assembly whereby the rack constitutes a part of the housing wall so as to permit a maximum diameter for the spindle gear.

Although but one specific embodiment of this invention has been herein shown and described it will be understood that details of the construction shown may be altered or omitted without departing from the spirit of the invention as defined by the following claims.

I claim:

1. In a door closing mechanism having a spring closing unit, a traveling spindle sub-assembly comprising a frame portion mounted in fixed position within said closing unit,

a rack fixed on said frame portion, a spindle having a gear connection with said rack and projecting from said closing unit for fixed connection with an operating arm whereby said spindle will be rotated and thereby moved longitudinally of said rack when said door is opened, and means connected with said spindle and movable therewith for actuating the spring closing unit in response to said longitudinal movement.

2. In a door closing mechanism having a spring closing unit, a traveling spindle sub-assembly comprising a frame portion mounted in fixed position within said closing unit, a rack fixed on said frame portion, a spindle having a gear thereon meshed with said rack, an arm fixed to said spindle for connection with a door frame whereby said spindle and gear will be rotated when said mechanism is operated by the opening of a door, the rotation of said gear on said rack causing translatory movement of the spindle longitudinally of said rack and said frame, longitudinal guiding means on said frame, a traveling carriage mechanism for supporting said spindle and mounted within said guiding means for longitudinal movement relative to said frame, and means connected to said carriage mechanism for tensioning the spring closing unit in response to said longitudinal movement.

3. In a door closing mechanism having a spring closing unit, a traveling spindle sub-assembly comprising a frame portion, a rack fixed on said frame portion, a spindle having a gear connection with said rack, an arm fixed to said spindle and having a connection whereby said spindle and gear will be rotated and moved longitudinally in said rack when said mechanism is operated in response to opening of a door, longitudinal guiding means on said frame, a traveling carriage mechanism mounted for longitudinal movement in said guiding means and adapted to receive said spindle rotatively for longitudinal movement therewith, and means connected to said carriage mechanism for tensioning the spring closing unit in response to said longitudinal movement.

4. In a door closing mechanism having a spring closing unit, a traveling spindle sub-assembly comprising a frame portion fixed within said closing unit, a rack fixed on said frame portion, a spindle having a gear connection with said rack, an arm fixed to said spindle and gear having a connection whereby said spindle and gear will be rotated and moved longitudinally on said rack when said mechanism is operated by the opening of a door, two longitudinally extending substantially U-shaped guide members comprising the sides of said frame portion, a traveling carriage mechanism mounted within each of said U-shaped guide members for longitudinal movement with said spindle, said spindle being journaled on and extending between said carriage mechanisms, a yoke member extending between said carriage mechanisms and adapted to be moved thereby, and a clevis pivotally mounted on said yoke member and connected to said spring closing unit.

5. In a door closing mechanism having energy storing means for closing a door after opening movement thereof, a traveling spindle assembly comprising a fixed frame having a rack extending along one side thereof, a slidable carriage mounted in said frame for movement longitudinally of said rack, a spindle journaled on said carriage transversely of said rack and having a pinion in driving engagement with said rack, and means for providing a driving connection between said slidable carriage and said energy storing means.

6. The spindle assembly defined in claim 5 wherein a slidable carriage is mounted in the frame on each side of the rack, the spindle is journaled on and extends between the cariages, and the means for providing driving connection with the energy storing means is a yoke attached to and extending between the said cariages.

7. The spindle assembly defined in claim 6 wherein each of the slidable carriages is mounted in a guide means extending parallel with the said rack, and each carriage is provided with bearing means acting between the carriage and the guide means from the side of the frame opposite said rack.

8. The spindle assembly defined in claim 6 wherein the spindle extends through each carriage and projects laterally from the frame, the frame having opening slots extending parallel with the rack for passage of the spindle to the exterior of the frame.

9. In a door closing mechanism having energy storing means for closing a door after opening movement thereof, a traveling spindle assembly comprising a fixed frame, a plurality of laminar members supported in stacked relation along one side of said frame and defining an inwardly facing rack means, a plurality of laminar members secured together in stacked relation and defining a movable carriage, means in said frame for guiding said carriage longitudinally of said rack means, a rotatable spindle journaled in said carriage and including pinion means fixed on the spindle and in driving relation with said rack means for moving said carriage longitudinally with respect to said rack and said frame upon rotation of the spindle in one direction, and means for providing a driving connection between said carriage and said energy storing means for energizing the same when said spindle is rotated in said one direction.

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