July 30, 1968 F. C. PETERSON 3,394,428

HINGE

Filed Oct. 14, 1965

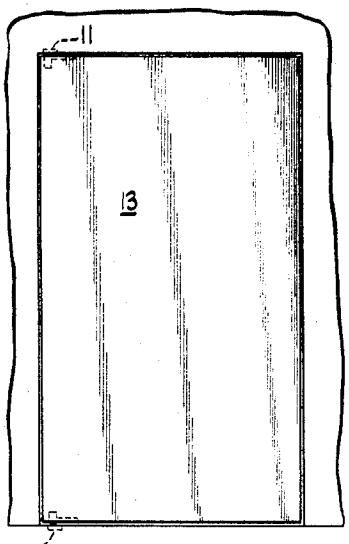


Fig 1

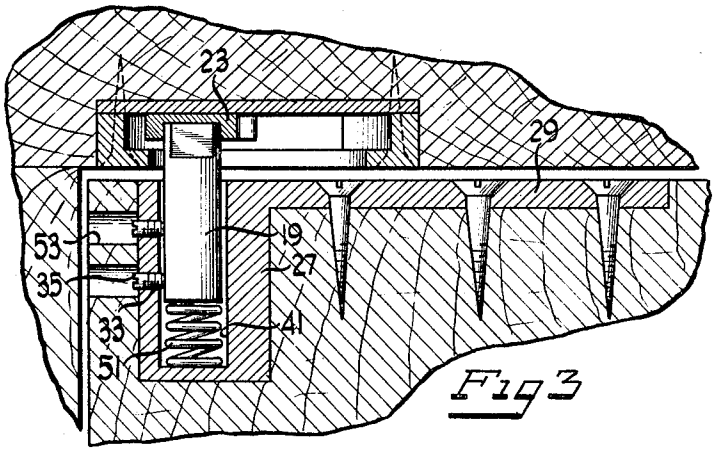


Fig 3

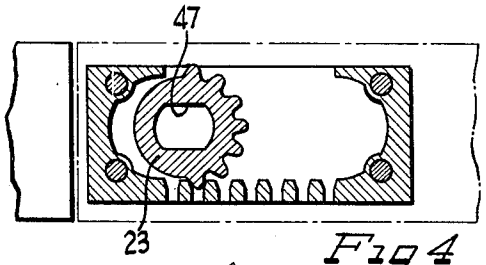


Fig 4

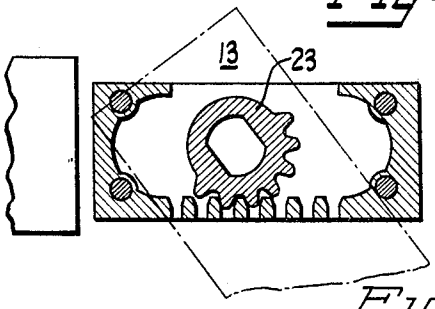


Fig 5

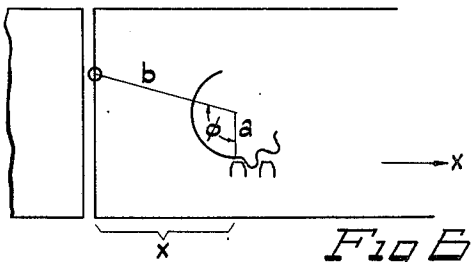


Fig 6

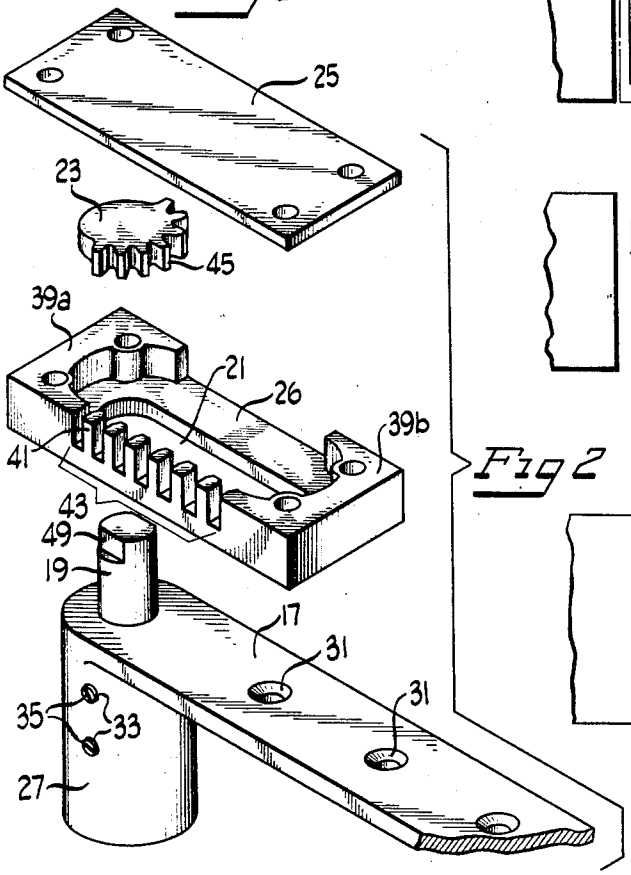


Fig 2

INVENTOR
FRANCIS C. PETERSON

BY Anderson, Luedeka, Fitch, Even & Tabin
ATTORNEYS

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HINGE

Francis C. Peterson, 3232 Dakota, Minneapolis, Minn. 55416

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ABSTRACT OF THE DISCLOSURE

A hinge for concealed use in a door. The hinge includes a gear rack and pinion enabling the door to be disposed in closely adjacent or substantially abutting relation to the door frame member. The hinge includes mounting means comprising a pin, biasing means, and releasable retaining means, the biasing means being adapted to urge the pin into engagement with the pinion.

The present invention relates, generally, to hinges and, more particularly, it relates to hinges for doors which are mounted in substantially abutting relationship to the supporting jamb.

Frequently, especially in cabinetry or doors in panelled walls, it is desired to mount a door in closely-adjacent relationship to its jamb, threshold and transom member. Such doors sometimes are mounted flush with the door frame.

A problem which arises with such doors is providing for clearance between the hinge side of the door and the supporting jamb when the door is opened. Unless special provision is made, the hinge side of the door will, upon opening, hit the supporting jamb. In the past, this has been avoided either by rounding the hinge side of the door so that it clears the jamb or by the use of hinges which extend outwardly from the door so that the pivot axis of the hinge is away from the frame. Rounding of the hinge side detracts from the appearance of the door, especially in flush-mounted installations, whereas outwardly-projecting hinges are also unsightly.

It is the primary object of the present invention to provide an improved, concealed hinge. A more particular object of the present invention is to provide an improved concealed hinge for a door which is mounted closely adjacent to its supporting jamb. Other objects and advantages of the invention will become apparent from the following description and drawing, in which:

FIGURE 1 is a fragmentary view in elevation of a door, hinges, and door frame embodying the features of the present invention;

FIGURE 2 is an exploded perspective view of a hinge constructed in accordance with the present invention;

FIGURE 3 is a cross-sectional view of the hinge of FIGURE 2 as mounted in the door and door frame of FIGURE 1;

FIGURE 4 is a cross-sectional view of a portion of the hinge, taken along lines 4—4 of FIGURE 3, when the door is in its closed position;

FIGURE 5 is a cross-sectional view of the hinge showing the door in a partially open position; and

FIGURE 6 is a diagrammatic view of the spatial relationship of certain elements of the hinge.

In accordance with the present invention, and with reference to the drawing, there are provided two hinges **11** by which a door **13** is mounted in a door frame **15**. As illustrated in FIGURE 1, the hinges **11** are concealed hinges, that is, the hinge elements are mounted in the door or the door frame so that they are substantially concealed from view.

As particularly illustrated in FIGURE 2, each hinge **11** comprises a door mounting member **17**, a keyed pin **19**, a gearplate **21**, a pinion **23** and a cover plate **25**. The door mounting member **17** comprises a generally cylindrical leg **27** and a generally flat leg **29**. The flat leg **29** includes openings **31** formed therein adapted to receive screws therethrough which fasten the door mounting member **17** to the door **13** (FIGURE 3). The cylindrical leg **27** further includes tapped openings **33** in which are disposed set screws **35** which engage the keyed pin **19** to retain it in desired position.

The gearplate **21** comprises a generally rectangular casting or the like which is provided with an elongated slot **37**. The slot **37** is of a width to accommodate the keyed pin **19** therethrough. Shoulders **39***a* and **39***b* are provided at either end of the gearplate **21**, and between the shoulders **39***a* and **39***b* along one side of the gearplate are disposed lugs **41** which in combination define a rack **43** extending along that side.

The pinion **23** is received in the gearplate **21** between the shoulders **39***a* and **39***b*, and includes gear teeth **45** which mesh with the rack **43**. As best illustrated in FIGURES 4 and 5, the pinion **23** includes a keyway which receives the keyed end **49** of pin **19**.

As best seen in FIGURE 3, pin **19** is recessed within an opening **41** within the cylindrical leg **27** of the door mounting member. The opening **41** is further provided with a spring **51** which serves to extend the keyed end of the pin **19** into the keyway of the pinion **23**.

When setting the door in the hinges **11** the pin **19** is depressed until flush with the flat leg **29** of the door mounting member and is retained in this position by tightening the set screws **35**. When the door is positioned so that the pin **19** is located directly beneath or above the keyway of the pinion **23**, the set screws **35** are released and the keyed end of the pin **19** is forced into interlocking communication with the keyway of the pinion **23** after which the screws are tightened to provide interlocked unit. To facilitate operation of the set screws **35** pilot holes **53** are drilled in a non-visible surface of the door. The cylindrical leg **27** of the door mounting member **30** is provided with three sets of tapped openings **33** spaced at 90° intervals so that any of three surfaces may be selected for drilling the pilot holes **53**.

The cover plate **25** comprises a generally rectangular plate which, when secured to the top of the shoulders **39***a* and **39***b* of the gearplate **21**, defines a partially enclosed gearway **26** in which the pinion **23** is confined.

As particularly illustrated in FIGURE 3, when in operating position, the gearplate, pinion, and cover plate are mounted in a recess in the threshold and sill of the door. (In the following descriptive matter, the terms "threshold," "sill," and "supporting jamb" will be used in their normal sense, although it should be understood that the construction of the hinge of the present invention does not actually "support" the door from the "supporting jamb." Furthermore, it is obvious that the door may be horizontally hinged as well as vertically hinged.) The keyed pin **19** is received in the keyway **47** of the pinion **23** through the elongated slot **37** of the gearway **21**.

In accordance with the present invention, as the door **13** is opened, the pinion, which is fixedly connected by the keyed pin to the door, is caused to rotate and, concurrently with such rotation, is caused to move laterally away from the supporting jamb of the door. As particularly illustrated in FIGURES 4 and 5, such combined rotational and lateral movement enables the door to be mounted in closely-adjacent, or even substantially abutting relation to the supporting jamb adjacent to the pivoted edges. In FIGURE 4, with the door in its closed position, it will be seen that the door **13** substantially abuts the jamb **51**. In FIGURE 5, the door is illustrated in a

partially open position, and it will be seen that the edge of the door is caused to move laterally away from the jamb **51** so that it clears the jamb.

In this connection, it should be noted that points along the pivoted edge of the door move in an arcuate attitude when the door is opened that corresponds to a cycloid, which is defined as the curve described by a point at a fixed distance from the center of a circle which rolls along a fixed straight line. The cycloid may be further characterized as being a prolate cycloid, curtate cycloid, or cycloid, depending upon whether the distance of the fixed point from the center of the rolling circle is greater than, less than, or equal to the radius of the circle.

As shown in FIGURE 6, each point along the pivoted edge of the door is at a fixed distance from the center of the pinion which is greater than the pitch radius of the pinion. The points along the pivoted edge of the door from corner to corner of the door thus described an arcuate movement corresponding to a prolate cycloid when the pitch radius of the pinion is less than half the thickness of the door **13**. Pitch radius being defined as the distance from the center of the pinion to the point at which the pinion engages the gear rack.

The equation for movement of cycloid curves in the direction away from the door jamb (hereafter called the x direction) is as follows: $x=a\phi-b \sin \phi$, where a is the pitch radius of the pinion, b is the distance to any point on the pivoted edge of the door and ϕ is the angle between a line directed to the point from the center of the pinion and a line from the center of the pinion perpendicular to the gear rack. It can be seen from this equation that for cycloid and curtate cycloid curves, movement of any point on the pivoted edge of the door will always be in the positive x direction, that is, away from the door jamb. Therefore, it is an important feature of this invention that the spatial relationship between the pinion **23** and the distance from the center of the pinion to the pivoted edge of the door be such that movement of all points along the pivoted edge is substantially in the positive x direction away from the door jamb.

As a specific example of the practice of this invention, for a door with a thickness of 1¾ inches and a pinion with a pitch radius of 7/16 inch, it is preferred to locate the center of the pinion at a distance of ¾ inch from the pivoted edge of the door and equidistance from the two edges of the door. The ratio of the pitch radius to half the thickness of the door for this example is about 1:2.

It would also be possible to provide pinions **23** of various radii for use with doors of different thickness. However, it is considered economically advantageous to provide a standard size pinion with mounting instructions for use with doors of varying thickness.

Various of the features of the invention are set forth in the following claims.

What is claimed is:

1. A hinge for concealed use in pivoting a door, the hinge being adapted so that the pivoted edge of the door may be disposed in closely adjacent or substantially abutting relation to a door frame member, the hinge comprising, in combination, a pinion having a keyway, means defining a gearway and a gear rack in which said pinion is engageable, and mounting means, said mounting means comprising a pin, biasing means, and releasable retaining means, said biasing means being adapted to urge said pin into the keyway of said pinion when the door is in operating position between door frame members, said releasable retaining means cooperating with said biasing means so as to retain said pin in a predetermined retracted position until the door is positioned between the door frame members and so as then to release said pin, the spatial relationship of said pinion and said gearway means with respect to the pivoted edge of the door being such that progressive opening movement of the door from its closed position results in movement of the pivoted edge of the door substantially away from the door frame member adjacent to the pivoted edge of the door.

2. A hinge for concealed use in pivoting a door, the hinge being adapted so that the pivoted edge of the door may be disposed in closely adjacent or substantially abutting relation to a door frame member, the hinge comprising in combination a pinion having a keyway, means defining a gearway and a gear rack in which said pinion is engageable, and mounting means, said mounting means comprising a pin adapted to engage said keyway of said pinion, spring means for urging said pin to engage said keyway and set screws, said set screws being adapted to fix the location of said pin at various locations so as to retain said pin in a predetermined retracted position until the door is positioned between the door frame members and so as then to release and secure said pin, the pitch diameter of said pinion and the spatial relationship of said pinion and said gearway means with respect to the pivoted edge of the door being such that progressive opening movement of the door from its closed position results in movement of the pivoted edge of the door substantially away from the door frame member adjacent to the pivoted edge of the door.

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BOBBY R. GAY, *Primary Examiner.*

D. L. TROUTMAN, *Assistant Examiner.*