HANDS-FREE DOOR OPENER

REFERENCE TO RELATED APPLICATIONS

This application claims priority to, and the benefit of U.S. Provisional Patent Application No. 63/568,028, filed on March 21, 2024, the contents of which are incorporated by reference in their entirety as if fully set forth herein.

TECHNICAL FIELD

This disclosure relates to door opening mechanisms, specifically to a foot-operated door-opening device enabling the opening of doors without the need for hand contact.

BACKGROUND

In the realm of public health and hygiene, the transmission of pathogens and germs through common surfaces in public and private spaces has been a longstanding concern. Traditional door-opening mechanisms, such as handles and knobs, necessitate direct physical contact, usually hand contact. This mode of operation poses a significant risk for the transfer of microorganisms, including bacteria and viruses, from person to person. The concern is particularly acute in environments with high traffic and usage rates, such as public restrooms, hospitals, and food preparation areas, where the potential for cross-contamination is significantly higher. The need for maintaining hygiene standards in such environments is critical to preventing the spread of infectious diseases.

Public and communal environments, including restrooms, hospitals, food service establishments, and educational facilities, are high-traffic areas where individuals frequently come into contact with various surfaces, including door handles. These surfaces can serve as vectors for the transmission of a wide array of pathogens, including bacteria, viruses, and fungi, leading to the spread of infectious diseases. Among the most common pathogens that can be transmitted through contact with contaminated surfaces are the influenza virus, norovirus, Escherichia coli, Staphylococcus aureus, and various strains of coronavirus, including those responsible for the outbreak of diseases such as COVID-19.

The transmission of these pathogens can occur when an individual touches a contaminated surface and subsequently touches their face, particularly the mucous membranes of the mouth, nose, or eyes, facilitating the entry of these pathogens into the body. This mode of transmission is especially concerning in public restrooms, where the

presence of fecal bacteria adds to the risk of disease spread. Handwashing is a critical measure in preventing disease transmission; however, the necessity to touch door handles after washing hands can negate the benefits of this practice.

Various solutions have been proposed and implemented to address the issue of germ transmission through door handles, including the use of antimicrobial coatings and the encouragement of hand hygiene practices. However, these approaches have limitations. Antimicrobial coatings can wear off over time and require regular maintenance, while promoting hand hygiene relies heavily on individual compliance, which cannot be guaranteed. Moreover, in certain environments, the ability to wash hands before touching a door handle may not always be feasible.

The advent of touchless technology, such as automatic doors, has offered a way to mitigate the issue of direct contact with door surfaces. However, the cost, complexity, and space requirements of installing such systems can be prohibitive, particularly in existing structures or smaller spaces where retrofitting may not be easily accomplished. Additionally, automatic door systems often require electrical power, which can further complicate their installation in locations without readily available electrical infrastructure or in scenarios where power reliability is a concern.

The spread of infections through surface contact in public settings contributes significantly to public health challenges, including increased incidence of illness, heightened demand on healthcare resources, and the economic impact associated with lost productivity and medical care. In light of these challenges, there is a recognized need for innovative approaches to reduce the risk of pathogen transmission through surface contact, especially in high-risk environments such as public restrooms. The development of mechanisms that can minimize direct hand contact with potentially contaminated surfaces presents a potential strategy to enhance public health and safety by reducing the spread of infectious diseases.

Therefore, there exists a need for a simple, cost-effective solution that can be easily implemented in a wide range of environments to reduce the risk of germ transmission through door surfaces. Such a solution should ideally be mechanically simple, not reliant on electrical power, and capable of being retrofitted to existing door mechanisms without extensive modifications. The solution should enhance public health and hygiene practices in

a manner that is accessible and practical for a broad spectrum of facilities, from public restrooms and hospitals to private homes and commercial kitchens.

SUMMARY

In a first general aspect, there is provided a hands-free door operating apparatus for a hinged door, comprising a housing configured to be attached to the door. A first activation mechanism extends from the housing and includes an activation arm arranged to receive foot pressure. An opening mechanism also extends from the housing and includes an opening arm configured for coupling to a structure adjacent the door and for imparting a pulling or pushing force to the structure to cause the door to open or close, respectively. Movement of the activation arm in response to foot pressure activates the opening mechanism, thereby providing a hands-free mechanism for moving the door from a closed position toward an open position.

In some embodiments of the first general aspect, the activation mechanism is a first rotatable gear shaft, and the opening mechanism is a second rotatable gear shaft. Further embodiments include a closing rack and pinion assembly operably associated with the first rotatable shaft, and an opening rack and pinion assembly operably associated with the second rotatable shaft, wherein each rack and pinion assembly is configured to convert rotational movement of its respective rotatable shaft into linear movement of its respective rack. Still further, the apparatus may include a first spring biasing the closing rack toward the opening rack, and a second spring biasing the opening rack toward the closing rack, wherein the first spring has a greater spring force than the second spring.

In additional embodiments, a toggle lever is arranged to block the closing rack from returning under the force of the first spring until the opening rack moves sufficiently to rotate the second rotatable shaft. The toggle lever may be spring-biased to shift between a blocking position and a releasing position relative to the closing rack. In another embodiment, a linkage is attachable to the opening arm and to a structure adjacent the door, such that rotation of the second rotatable shaft through the opening arm pulls or pushes the door relative to the structure. The linkage may be pivotally connected to the opening arm at a first end and to the structure at a second end. Each of the closing rack and the opening rack may be formed as a hollow elongate cylinder that at least partially encloses its respective spring.

In a second general aspect, there is provided a hands-free door operating apparatus for a hinged door, comprising a housing attachable to the door and enclosing a first rack-and-pinion assembly and a second rack-and-pinion assembly, each having first and second racks and springs, respectively, the first and second racks being independently biased toward each other by the first and second springs. The spring force of the first spring is greater than the spring force of the second spring. An activation arm is coupled to the first rack-and-pinion assembly and arranged to translate the first rack and compress the first spring in response to foot pressure, thereby permitting the second rack to translate under the urging force of the second spring. An opening arm is mechanically linked to the second rack-and-pinion assembly and arranged to be coupled via a linkage to a structure adjacent the door, such that the door is moved from a closed position toward an open position by a single action of the activation arm, and is subsequently returned to the closed position by the first spring.

In some embodiments of the second general aspect, a toggle lever is arranged to hold the first rack in its compressed position against the first spring while allowing the second rack to translate under the urging force of the second spring and to release the first rack after the second rack has advanced sufficiently to open the door. In alternative embodiments, the toggle lever is arranged to restrain the first rack from movement under the force of the stronger, first spring, until the second rack has shifted sufficiently to switch the toggle lever and release the first rack, after which the stronger spring urges the second rack to shift the door from the open position back toward the closed position.

In further embodiments, the toggle lever is pivotally mounted on a pillar of the housing and includes an abutment portion configured to engage an end portion of the first rack. The toggle lever may be urged upward, toward the translation plane of the first and second rack, by a lever spring that biases the abutment portion into a blocking position until the second rack translates sufficiently to push the toggle lever downward, away from the translation plane of the first and second rack. The first and second racks may each be a hollow elongate cylinder that partially contains its respective spring within an interior cavity, and may be arranged generally parallel to one another within the housing. A foot pedal may also be disposed at a distal end of the activation arm and positioned to receive a user's foot when the housing is mounted on a lower portion of the door.

In a third general aspect, there is provided a hands-free door operating apparatus for a hinged door, comprising a housing attachable to the door. A first gear shaft is disposed at least partially within the housing and includes an activation arm configured to receive a foot input. A second gear shaft is also disposed at least partially within the housing and includes an opening arm arranged to couple, via a linkage, to a structure adjacent the door. A first rack and pinion assembly is associated with the first gear shaft and biased by a first spring of greater force. A second rack and pinion assembly is associated with the second gear shaft and biased by a second spring of lesser force.

A toggle lever is included in the housing and is configured to hold the first rack in a compressed state against the bias of the first spring when the activation arm is depressed, thereby permitting the second rack to translate under the bias of the second spring and rotate the second gear shaft to move the door from a closed position toward an open position. The toggle lever subsequently releases the first rack so that the first spring shifts the second rack and returns the door toward the closed position. In this manner, opening and closing of the hinged door is accomplished through a single foot-actuated motion.

In some embodiments of the third general aspect, the toggle lever is pivotally mounted in a base region of the housing and includes an abutment portion configured to engage the first rack as the activation arm is depressed. Additionally, each of the first and second racks may be formed as a hollow elongate cylinder that at least partially encloses its respective spring.

The hands-free door opener, as detailed herein, presents several significant advantages over traditional door opening methods, particularly in enhancing usability, promoting hygiene, and ensuring accessibility. These benefits are essential in both public and private settings, reflecting broad applicability and potential to address contemporary needs.

One advantage of the opener is its contribution to improved hygiene. By enabling users to open and close doors without using their hands, the risk of transmitting germs and viruses through door surfaces is significantly reduced. This aspect is especially valuable in healthcare settings, such as hospitals and clinics, where maintaining a sterile environment is crucial to prevent the spread of infections. Moreover, during periods of heightened public health concerns, such as during flu seasons or pandemics, the hands-free operation can

contribute to public health safety in commercial and educational establishments by minimizing contact points that can harbor pathogens.

Another advantage of the hands-free door opener is its enhanced accessibility. The opener is particularly advantageous for individuals with disabilities or those who may have difficulty using traditional doorknobs or handles due to physical limitations. The foot-operated mechanism allows for greater independence for people with upper limb mobility challenges, making it a considerate addition to public buildings, restrooms, and residential homes aiming to be more inclusive. The simple act of using one's foot to activate the door opener makes entry and exit more accessible for everyone, including those carrying heavy loads or parents with strollers, enhancing overall user convenience.

The opener features durability and compatibility with various door types, thanks to its robust construction and adaptable design. The use of sturdy materials like steel or aluminum for the housing ensures that the opener can withstand the wear and tear of everyday use, cleaning, and resistance to chemicals, especially those used in commercial, business, hospital or other non-residential settings, and is suitable for high-traffic areas. Its versatility in being mountable on swinging doors of any material enhances its applicability across different architectural styles and settings, from modern office buildings, to hospitals, to traditional educational institutions and others. The inclusion of internal spring mechanisms within the rack and pinion assemblies ensures a smooth and reliable operation, contributing to the longevity of the device and reducing the need for frequent maintenance.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art. Although methods and materials similar or equivalent to those described herein can be used in the practice or testing of any described embodiment, suitable methods and materials are described below. In addition, the materials, methods, and examples are illustrative only and not intended to be limiting. In case of conflict with terms used in the art, the present specification, including definitions, will control.

The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description and claims.

BRIEF DESCRIPTION OF DRAWINGS

The present embodiments are illustrated by way of the figures of the accompanying drawings, which may not necessarily be to scale, in which like references indicate similar elements, and in which:

FIG. 1 is an isometric view of a hands-free door opener according to one embodiment;

FIG. 2 illustrates the opener operatively attached to a hinged door, according to one embodiment;

FIG. 3 is a left side elevational view of the opener of FIG. 1;

FIG. 4 is a left side elevational view of the opener shown in FIG. 3, with a housing of the opener removed;

FIG. 5 is a right side elevational view of the opener shown in FIG. 4;

FIG. 6 is a magnified view of a base and toggle switch of the opener, according to one embodiment;

FIG. 7 depicts rotation of an opening arm and movement of internal components of the opener, according to one embodiment;

FIG. 8 is a magnified view of the base and toggle switch of the opener during opening operations, according to one embodiment;

FIG. 9 is a magnified view of the base of the opener, showing internal components, according to one embodiment;

FIG. 10 illustrates movement of internal components of the opener during a door-opening operation, according to one embodiment;

FIG. 11 illustrates motions of internal components of the opener during a door-opening operation, when the door is fully open, according to one embodiment; and

FIG. 12 illustrates motions of internal components of the opener after a door-opening and closing operation is complete, according to one embodiment.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

FIG. 1 is a hands-free door opener 100 (hereinafter 'opener') according to one embodiment. The opener 100 provides 'hands-free' opening and closing of swinging doors of the type that are hinged on one side to a wall or other framework. The term 'hands-free' carries its ordinary meaning. In the context of this disclosure, 'hands-free' relates to the

operation of opening and closing of doors without the use of a person's hands to carry out the operation.

In this embodiment, the opener 100 includes a housing 101 that encloses various mechanical components that will be described in greater detail herein. The housing is made from a sturdy material such as steel, aluminum or other material that is resistant to normal wear and tear for the types of operations described herein. In this embodiment, the housing 101 includes three through-apertures, 102, 103, 104 that allow the housing 101 to be securely attached to a door through the use of screws, bolts, or other appropriate fastening mechanisms. The housing 101 can be attached to swinging doors of any type, made from any material, and is intended to be mounted at a lower portion of the door where foot-operated activation can be accomplished. In this embodiment, the opener 100 includes a front face 110 and a rear face 115, opposite the front face as illustrated.

Referring briefly to FIG. 2, when installed on a door D, the opener 100 is oriented such that the front face 110 is nearest the handle-side of the door D, and the rear face 115 is nearest the hinged side H of the door D, as illustrated. Completing the installation, an anchor 160 is securely attached to a portion of a wall W in which the door D is installed; or, optionally, the anchor 160 can be attached to a wall adjacent to the wall in which the door D is installed. A tie rod 150 is attached to the anchor 160 at a distal end, and to the opener 100 at a proximal end, as described in greater detail below.

Referring back to FIG. 1, in this embodiment, the opener 100 includes an activation mechanism. In this example, the activation mechanism is a first rotatable gear shaft 165. The distal end portion of the first rotatable gear shaft 165 extends outside of the housing 101 through a first aperture closest to the front face 110 and is coupled at the distal end portion of the first rotatable gear shaft, via first hub 120, to a proximal end (125) of an activation arm 130. The first gear shaft 165 is operatively connected to a 'closing' rack-and-pinion assembly 185 described in greater detail herein. In alternative embodiments, the activation mechanism can be, for example and without limitation, a sliding gear shaft or other mechanism. A foot pedal 135 is attached to the distal end (137) of the activation arm 130 as illustrated. The foot pedal 135 is appropriately sized and shaped to receive a foot or shoe of the user and can be texturized, surfaced, or have materials applied thereon to provide ample grip as a user operates the activation arm 130. The activation arm 130 rotates in the general direction of the

dashed double-arrow in FIG. 1, causing the first gear shaft 165 to rotate about its axis and drive the rack-and-pinion assembly 185 as described in greater detail herein. The first hub 120 can include keys, splines set-screws, or other locking hardware to securely lock the activation arm 130 to the first gear shaft 165, ensuring that the two components remain connected, facilitating synchronous rotation without slipping.

In this embodiment, the opener 100 includes an opening mechanism. In this example, the opening mechanism is a second rotatable gear shaft 170. The distal end portion of the second gear shaft 170 extends through a second aperture of the housing 101, closest to the rear face 115, and is coupled via second hub 136, to a proximal end (142) of an opening arm 140 as illustrated. The second rotatable gear shaft 170 is operatively connected to an 'opening' rack-and-pinion assembly 190 as described in greater detail herein. In alternative embodiments, the opening mechanism can be, for example and without limitation, a sliding gear shaft or other opening mechanism. The opening arm 140 includes a distal end portion 145 that connects to the proximal end of the tie rod 150 described with respect to FIG. 2. In this embodiment, the distal end 145 of the opening arm 140 includes an aperture that allows the opening arm to be coupled to the tie rod 150 using appropriate coupling or attachment hardware; however, other approaches may be utilized to accomplish coupling of the opening arm to the tie rod, as will be apparent to those skilled in the art. The second hub 136 can include keys, splines, set-screws or other locking hardware to securely lock the opening arm 140 to the second gear shaft 170, ensuring that the two components rotate together without slipping.

Referring now to FIGS. 3-12, the operation and mechanics of the opener 100 are now described, according to one embodiment. In the following description, some figure reference numerals are excluded for the sake of figure clarity. Beginning at FIG. 3, a left-side elevational view of the opener is shown. The opener is attached to a door (not illustrated in FIGS 3-12 for clarity) such that the right side, opposite the left side shown, confronts the door surface.

FIG. 4 illustrates the opener 100 in the same configuration as FIG. 3, with the housing removed to show internal components; however, the bounds of the housing 101 illustrated in dashed lines. The configuration of the opener 100 shown in FIGS. 3 and 4 is that of the 'ready configuration', wherein the door is closed and the opener 100 is ready to receive the

operator's foot upon the pedal 135 to cause activation of the opener 100. In this configuration, the activation arm 130 is positioned at about a forty-five degree upward angle as illustrated, although other angles may be used. Likewise, the opening arm 140 is positioned at about a 45 degree upward angle as illustrated, although other angles may be used.

In this embodiment, the opener 100 includes a closing rack and pinion assembly 185 and an opening rack and pinion assembly 190, each in communication with an internal compressed spring 200, 215, respectively. The opener 100 further includes a base 230 having a toggle lever 275 (see FIG. 6). The rack and pinion assemblies 185, 190 and base 230 cooperate to perform door opening and closing operations as will now be described in detail.

FIG. 5 is a right-side elevational view of the opener 100 with the housing 101 removed. Referring to FIGS. 4 and 5, in this embodiment, the closing rack and pinion assembly 185 includes a closing rack 195 and closing pinion 245. The closing pinion 245 is located on a proximal end portion of the first gear shaft 165 and positioned beneath, and so as to be engaged to, the closing rack 195. The closing rack 195 is a hollow, elongate cylinder that partially houses spring 200. The closing pinion 245 includes teeth that mesh with teeth 255 of the closing rack 195. The closing pinion 245 is circumferentially disposed on gear shaft 165, so that when activation arm 130 rotates, gear shaft 165 and closing pinion 245 drive the closing rack 195 laterally in left and right directions according to the convention of FIGS. 4 and 5, and vice-versa. The closing rack and pinion assembly 185 further includes a closing spring 200 that extends from an end cap 205 connected to the left side (180) of the housing 101 to a distal end 260 of the closing rack 195.

The opening rack and pinion assembly 190 includes an opening rack 210 and opening pinion 240. The opening pinion 240 is located on a proximal end portion of the second gear shaft 170 and positioned beneath, and so as to be engaged to, the opening rack 210. The opening rack 210 is a hollow, elongate cylinder that partially houses spring 215 (in FIGS. 4 and 5, spring 215 is compressed within the opening rack 210 and is therefore only partially visible). The opening pinion 240 includes teeth that mesh with teeth 250 of the opening rack 210. The opening pinion 240 is circumferentially disposed on gear shaft 170, so that when the opening rack 210 moves laterally according to the convention of FIGS. 4 and 5, opening pinion 240 and gear shaft 170 rotate synchronously, which drives rotation of arm 140 and

vice-versa. The spring 215 of the opening rack and pinion assembly 190 extends from an end cap 220 connected to the right side (225) of the housing 101, to a distal end 265 of the opening rack 210.

Referring to FIGS. 6 and 9, in this embodiment, the base 230 includes a pillar 270 that supports a spring-loaded toggle lever 275. The toggle lever 275 can pivot about a shaft 290 between first and second configurations, wherein in the first configuration the toggle lever 275 is flat (i.e., horizontal), and in the second configuration, the toggle lever is tilted so that an abutment side 280 of the toggle lever is elevated as illustrated in FIG. 6. During operation of the opener 100, the abutment side 280 of the toggle lever 275 abuts a distal end portion (260) of the closing rack 195 as described in greater detail below. A vertically-oriented spring 285 is positioned beneath the abutment side 280 of the lever and applies a constant spring urging force in the upward direction, according to the convention of FIG. 9. The toggle lever 275 toggles between the first and second configurations as the racks 195, 210 shift, during the process of door opening, as will now be explained.

Referring to FIG. 4, again, the opener is in the 'ready configuration' where the door (not shown in FIG. 4) is in the closed position. In this configuration, closing spring 200 exerts an urging force against the left side 180 of the housing 101, thereby pushing closing rack 195 to the right, and also urging opening rack 210 to the right and compressing opening spring 215 against the right side 225 of the housing 101. Importantly, in this embodiment, spring 200 of the closing rack has a stronger spring force than opening spring 215; i.e., spring 200 overpowers spring 215, which keeps the door in the closed configuration until a user depresses pedal 135. In this 'ready configuration', toggle switch 275 is in a horizontal position.

Referring now to FIGS. 7, 8 and 9, in this embodiment, as the pedal 135 is depressed from the 'ready configuration', as illustrated by the downward curved arrow, the closing arm rotationally drives gear shaft 165 and pinion 245, thereby causing closing rack 195 to shift to the left from its original position in the 'ready configuration', according to the convention of FIG. 7. This movement is illustrated by the horizontal dashed arrow in FIGS. 7 and 8. As the closing rack 195 shifts to the left, spring 200 is simultaneously compressed, and the closing rack 195 no longer supplies an urging force against the opening rack 210.

As the closing rack 195 shifts to the left, the distal end (260) passes over the abutment side (280) of the toggle switch 275. At this point, now unencumbered by the closing rack 195, the abutment side (280) of the toggle switch 275 freely shifts upward under the urging force of spring 285, as illustrated by the vertical arrow in FIG. 8. In this configuration, the abutment side (280) of the toggle switch 275 prevents the closing rack 195 from shifting to the right (according to the convention of FIGS. 7-9) under the force of the closing spring 200. Closing rack 195 is prevented from shifting back to its original position until the toggle switch 275 is switched back to the horizontal configuration, as is now described in the next step of the door-opening process.

Referring now to FIG. 10, as the closing rack 195 shifts to the left, the opening rack 210, urged by compressed spring 215, shifts to the left (according to the convention of FIG. 10) as illustrated by the horizontal, left-pointing dashed arrow. As the opening rack 210 shifts, it rotationally drives the second gear shaft 170 and opening pinion 240 in the counter-clockwise direction in accordance with the convention of FIG. 10. Doing so simultaneously causes opening arm 140 to rotate counter-clockwise, pulling tie rod 150 to the left, as illustrated. The distal end of tie rod 150 is attached to a wall or frame of the door; thus, as the tie rod shifts to the left, the pulling force acts on the door since the housing 101 of the opener 100 is attached thereto. Accordingly, the door begins to open.

Continuing the present example and now referring to FIG. 11, the opening spring 215 continues to urge opening rack 210 to the left, further rotating opening arm 140 counter-clockwise and thereby pulling the door further open, while simultaneously urging closing rack 195 further to the left. As the opening rack 210 progresses further to the left, the toggle switch 275 is progressively shifted back down to a horizontal orientation, as illustrated in FIG. 11. Ultimately, the opening rack 210 pushes the closing rack 195 to a position where the toggle lever 275 attains a flat orientation and the abutment end 280 no longer confronts the distal end (260) of the closing rack 195. As mentioned, the closing spring 200 is characterized by a higher spring constant (k1) relative to that of the opening spring 215 (k2). This differential in spring constants results in the closing spring 200 exerting a force that is sufficient to counteract and overcome the force generated by the opening spring 215. Now, because the force of closing spring 200 can overcome the force of opening spring 215, the

closing rack 195 shifts back to the right, according to the convention of FIG. 11. Accordingly, the door begins the process of closing.

Referring now to FIG. 12, during the door-closing phase of operation, closing spring 200 urges closing rack 195 to the right, which causes simultaneous clockwise rotation of the closing pinion 245, and thereby resets activation arm 130 to the 'ready configuration' orientation. Simultaneously, closing spring 200 causes closing rack 195 to confront opening rack 210, forcing opening rack 210 to the right, thereby causing clockwise rotation of the opening pinion 240. Clockwise rotation of the opening pinion 240 (according to the convention of FIG. 12) causes opening arm 140 to rotate clockwise, which 'pushes' tie rod 150 against the structure that it is attached to (e.g., a door frame or wall adjacent to the door), having the effect of closing the door fully.

By way of the preceding example, a hand-free operation of opening and closing the door is accomplished by simply depressing pedal 135 with the foot of a user.

A number of illustrative embodiments have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the various embodiments presented herein. For example, while the foregoing description has described springs as the components that move the racks, other approaches can be substituted, for example, through the use of electric motors, hydraulic or pneumatic actuators, weights or other items. Accordingly, other embodiments are within the scope of the following claims.

WHAT IS CLAIMED IS:

1. A hands-free door operating apparatus for a hinged door, comprising:

a housing configured to be attached to the door;

a first activation mechanism extending from the housing, the first activation mechanism having an activation arm arranged to receive foot pressure; and

an opening mechanism extending from the housing, the opening mechanism having an opening arm configured for coupling to a structure adjacent the door and imparting a pulling or pushing force to the structure to cause the door to open or close, respectively;

wherein movement of the activation arm in response to foot pressure activates the opening mechanism, thereby providing a hands-free mechanism for moving the door from a closed position toward an open position.

2. The apparatus of claim 1, wherein the activation mechanism is a first rotatable gear shaft, and the opening mechanism is a second rotatable gear shaft.

3. The apparatus of claim 2, further comprising:

a closing rack and pinion assembly operably associated with the first rotatable shaft; and

an opening rack and pinion assembly operably associated with the second rotatable shaft;

wherein each rack and pinion assembly is configured to convert rotational movement of its respective rotatable shaft into linear movement of its respective rack.

4. The apparatus of claim 3, further comprising:

a first spring biasing the closing rack toward the opening rack; and

a second spring biasing the opening rack toward the closing rack;

wherein the first spring has a greater spring force than the second spring.

5. The apparatus of claim 4, further comprising a toggle lever arranged to block the closing rack from returning under force of the first spring until the opening rack moves sufficiently to rotate the second rotatable shaft.

6. The apparatus of claim 5, wherein the toggle lever is spring-biased to shift between a blocking position and a releasing position relative to the closing rack.

7. The apparatus of claim 2, further comprising a linkage attachable to the opening arm and to a structure adjacent the door, so that rotation of the second rotatable shaft through the opening arm pulls or pushes the door relative to the structure.
8. The apparatus of claim 7, wherein the linkage is pivotally connected to the opening arm at a first end and to the structure adjacent the door at a second end.
9. The apparatus of claim 3, wherein each of the closing rack and the opening rack is formed as a hollow elongate cylinder that at least partially encloses its respective spring.
10. A hands-free door operating apparatus for a hinged door, comprising:

a housing attachable to the door and enclosing a first rack-and-pinion assembly and a second rack-and-pinion assembly, each having first and second racks and springs, respectively, the first and second racks being independently biased toward each other by the first and second springs;

wherein the spring force of the first spring is greater than the spring force of the second spring;

an activation arm coupled to the first rack-and-pinion assembly arranged to translate the first rack and compress the first spring in response to foot pressure, thereby permitting the second rack to translate under the urging force of the second spring; and

an opening arm mechanically linked to the second rack-and-pinion assembly and arranged to be coupled via a linkage to a structure adjacent the door, such that the door is moved from a closed position toward an open position by a single action of the activation arm, and is subsequently returned to the closed position by the first spring.
11. The apparatus of claim 10, further comprising a toggle lever arranged to hold the first rack in its compressed position against the first spring while allowing the second rack to translate under the urging force of the second spring, and to release the first rack after the second rack has advanced sufficiently to open the door.
12. The apparatus of claim 10, further comprising a toggle lever arranged to restrain the first rack from movement under the force of the stronger, first spring, until the second rack has shifted sufficiently to switch the toggle lever and release the first rack, after which the stronger spring urges the second rack to shift the door from the open position back toward the closed position.

13. The apparatus of claim 12, wherein the toggle lever is pivotally mounted on a pillar of the housing and includes an abutment portion configured to engage an end portion of the first rack.
14. The apparatus of claim 13, wherein the toggle lever is urged upward, toward the translation plane of the first and second rack, by a lever spring that biases the abutment portion into a blocking position until the second rack translates sufficiently to push the toggle lever downward, away from the translation plane of the first and second rack.
15. The apparatus of claim 14, wherein each of the first and second racks is a hollow elongate cylinder that partially contains its respective spring within an interior cavity.
16. The apparatus of claim 15, wherein the first and second racks are arranged generally parallel to one another within the housing.
17. The apparatus of claim 10, further comprising a foot pedal disposed at a distal end of the activation arm and positioned to receive a user's foot when the housing is mounted on a lower portion of the door.
18. A hands-free door operating apparatus for a hinged door, comprising:

a housing attachable to the door;

a first gear shaft disposed at least partially within the housing and having an activation arm configured to receive a foot input;

a second gear shaft disposed at least partially within the housing and having an opening arm arranged to couple, via a linkage, to a structure adjacent the door;

a first rack and pinion assembly associated with the first gear shaft and biased by a first spring of greater force;

a second rack and pinion assembly associated with the second gear shaft and biased by a second spring of lesser force; and

a toggle lever in the housing configured to hold the first rack in a compressed state against the bias of the first spring when the activation arm is depressed, permitting the second rack to translate under the bias of the second spring and rotate the second gear shaft to move the door from a closed position toward an open position, the toggle lever subsequently releasing the first rack so that the first spring shifts the second rack and returns the door toward the closed position;

whereby opening and closing of the hinged door is accomplished through a single foot-actuated motion.

19. The apparatus of claim 18, wherein the toggle lever is pivotally mounted in a base region of the housing and includes an abutment portion configured to engage the first rack as the activation arm is depressed.

20. The apparatus of claim 19, wherein each of the first and second racks is a hollow elongate cylinder that at least partially encloses its respective spring.