March 1, 1955 E. WOLFF 2,703,250

LOCKING MECHANISM FOR COKE OVEN AND OTHER DOORS

Filed March 14, 1951 5 Sheets-Sheet 1

Fig.1

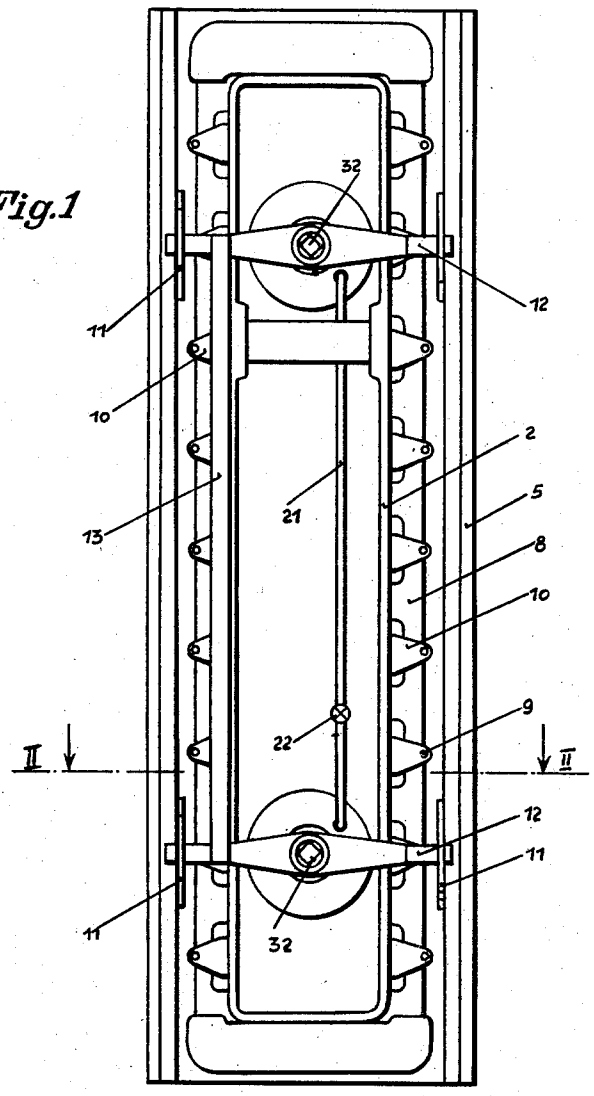


Fig. 1a

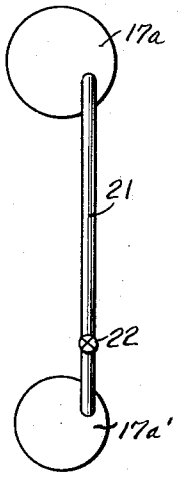
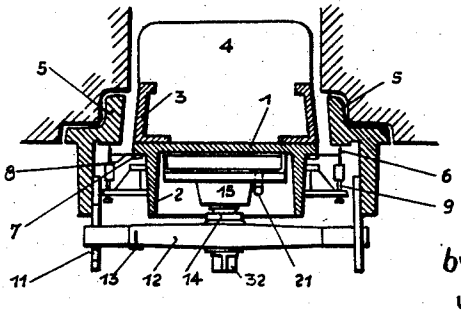


Fig.2



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LOCKING MECHANISM FOR COKE OVEN AND OTHER DOORS

Filed March 14, 1951 5 Sheets-Sheet 2

Fig. 3

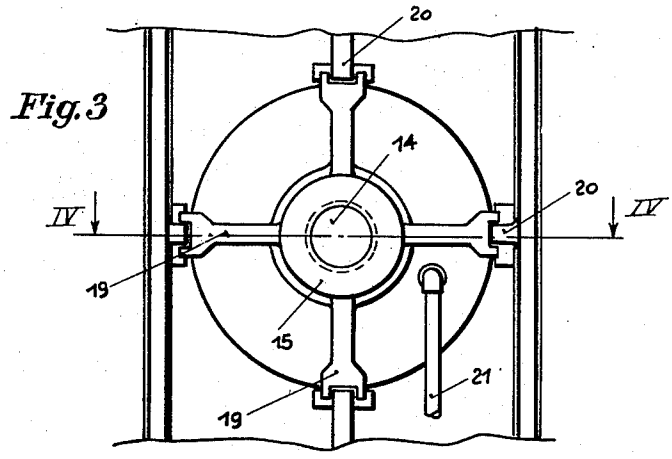
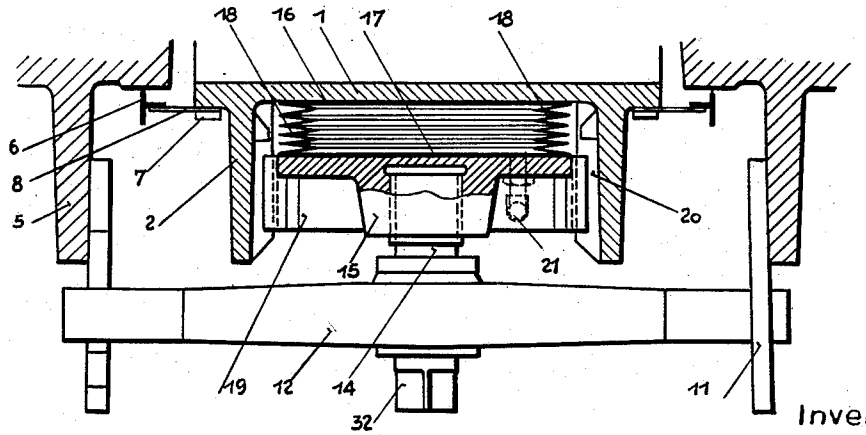


Fig. 4



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LOCKING MECHANISM FOR COKE OVEN AND OTHER DOORS

Filed March 14, 1951 5 Sheets-Sheet 3

Fig. 5

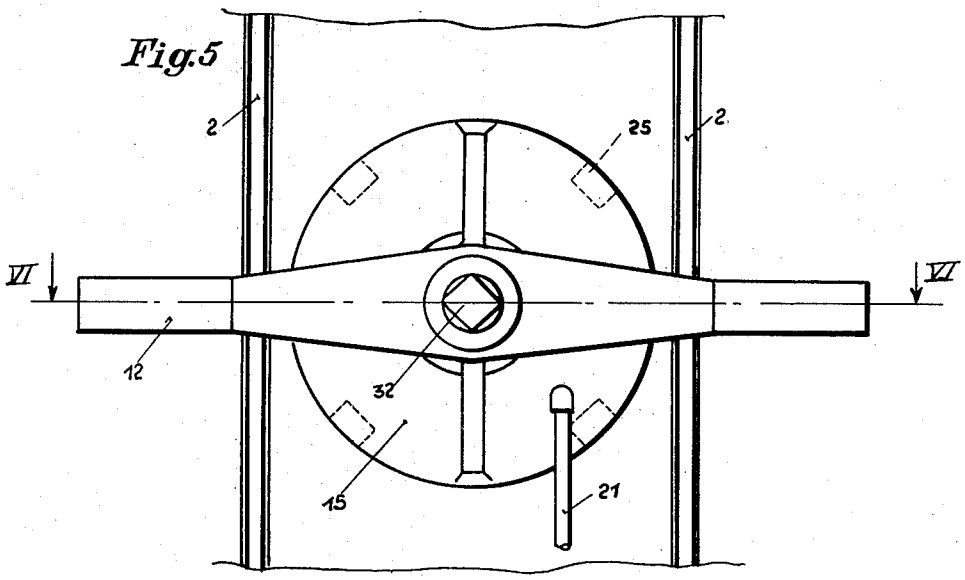
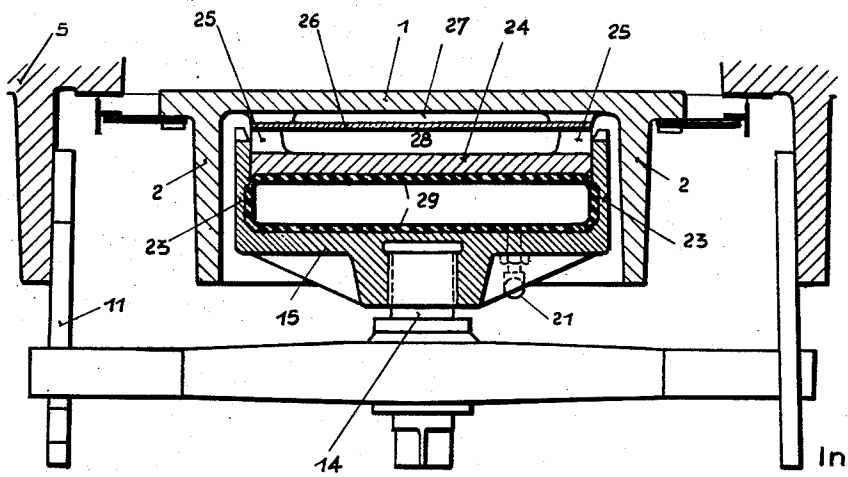


Fig. 6



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LOCKING MECHANISM FOR COKE OVEN AND OTHER DOORS

Filed March 14, 1951 5 Sheets-Sheet 4

Fig. 8

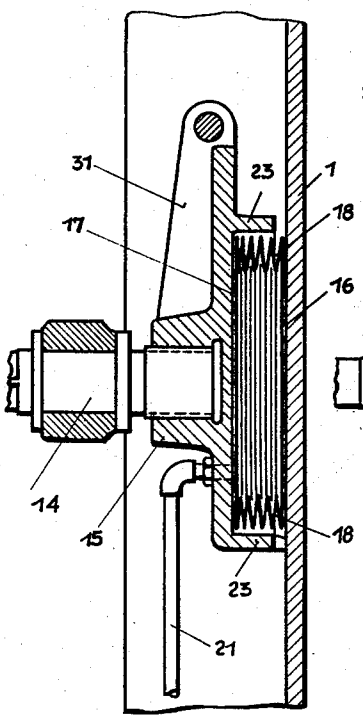
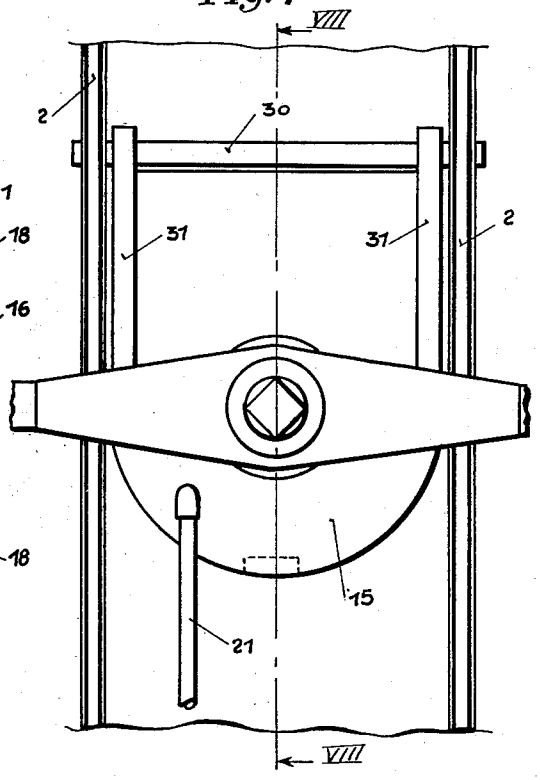


Fig. 7



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LOCKING MECHANISM FOR COKE OVEN AND OTHER DOORS

Filed March 14, 1951 5 Sheets-Sheet 5

Fig. 9

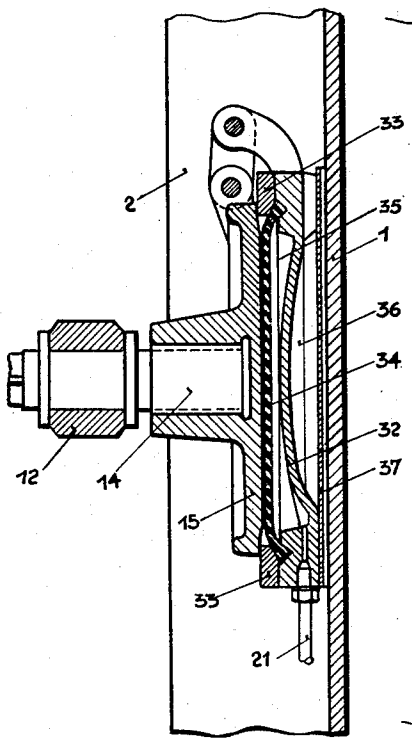
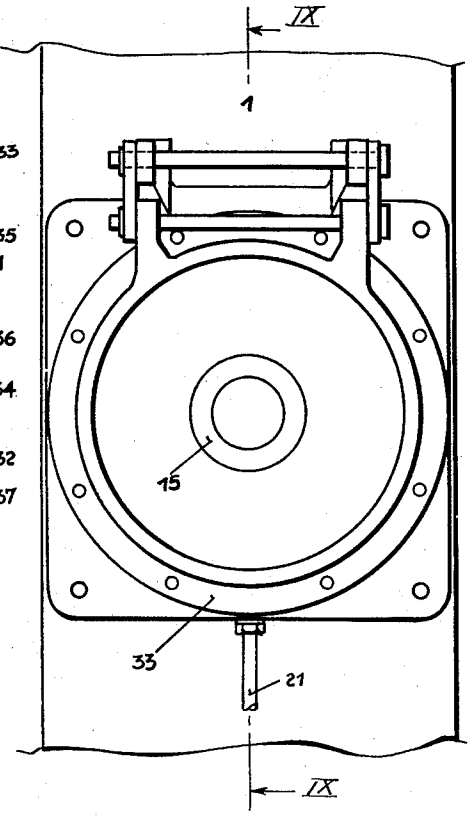


Fig. 10



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United States Patent Office 2,703,250
Patented Mar. 1, 1955

2,703,250

LOCKING MECHANISM FOR COKE OVEN AND OTHER DOORS

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Application March 14, 1951, Serial No. 215,479

17 Claims. (Cl. 292—259)

The present invention relates to doors and particularly to so-called self-sealing coke oven doors of conventional type. Such a door comprises a removable door body normally held under pressure against a stationary door frame so as to more or less completely prevent gas leakage between the door and door frame. Ordinarily, such a door includes one or more locking bars or bolts mounted on the door body for movement outwardly away from the door body into engagement with retaining elements connected to the stationary door frame, and includes means for forcible pressing the locking parts and door body apart to thereby press the door body inwardly against the door frame. The general object of the present invention is to provide novel fluid pressure means acting between the door body and the locking elements to create the desired door sealing pressure.

A so-called self-sealing coke oven door includes an endless strip of flexible packing material or an endless metallic edge running around the edge of the door and adapted to engage the front of a corresponding sealing face of the door frame. The door is pressed with considerable force against the frame, in order to produce a reliable seal. On modern doors, this pressure is usually produced by means of threaded spindles which are tightened up on insertion of the door and thereby tighten the door locks, which are arranged on the doors, against hooks disposed on the door frame and located opposite the door locks. Before the doors are opened the spindles are again loosened. Because the work of loosening and tightening the spindles takes time, and is also laborious and troublesome particularly in the case of the upper locks of the larger size coke oven doors, and as the magnitude of the spindle pressure may depend solely on the manual force which the operator can or wishes to exert, there have been a number of proposals to carry out mechanically the tightening and loosening of these spindles which carry the lock and to control the pressure exerted.

Known designs, so proposed, comprise rotatable claws, arranged on the door-operating-mechanism, which engage suitably designed heads on the spindles, and devices are provided in order to make possible a transmission of power even when the axis of the spindle and the axis of the driving mechanism on the door-operating-machine are not completely in line. The torque of the mechanical operating mechanism has been electrically governed, for example by means of slipping clutches. All such devices are rather complicated however, and satisfactory control of the torque is not invariably obtainable.

Another arrangement, described in British Patent 1,580 of 1914, but which, so far as is known has not been put into practical use, comprises a piston for generating a pressure between the door body and the door lock with the axis of said piston extending in the direction of the locking pressure. Although this arrangement may appear very simple, its application must fail because there is no piston which can be kept tight against the pressure medium, be it oil or compressed air, for the length of time during which a coke oven door needs to remain closed. Moreover, it would not be desirable to permanently connect the piston space to the feed line supplying the pressure medium, and to provide for the possible continual leakage losses of such medium.

In accordance with the present invention, in the locking of doors, and especially of coke oven doors and the leveling bar doors for coke ovens, the considerable pressure to which the doors should be subjected by the associated locking members, is maintained by the use of one or more

expansible vessels interposed in each door between the door body and the locking members mounted on the door body, and a connection for supplying a pressure medium, ordinarily air or oil, to each such vessel which is otherwise closed at all sides.

With the present invention, the magnitude of the door locking pressure is determined by the magnitude of the pressure of the pressure medium, and may be made whatever it needs to be to suit existing working conditions. The connection of the expansible vessel to a pressure supply pipe, or to a pressure generator to lock the corresponding door, and the opening of a valve to release the pressure and unlock the door, are simple operating procedures by use of which the locking and release of the door become considerably more simple than they have been with all previously known arrangements.

The expansible pressure chambers or vessels provided in accordance with the present invention may each be in the form of a hollow cylindrical or prismatic body with its axis extending in the direction of the locking pressure. Such a vessel ordinarily has plane bases or ends and a body which elongates when fluid under pressure is passed into the body. The capacity of the hollow body to elongate may be attained by providing the vessel with accordion-like side walls. The side walls may consist, for example, of a suitably bent metal body, or of rings set obliquely to each other and welded together at their edges. They may also be of non-metallic, elastic material and be joined to metallic bases by suitable means, as or example, by a clamping connection. The elongating walls may be supported on the outside against bulging.

The pressure vessel may also be a metal body having rigid sidewalls, and one or both end faces capable of bulging out, in like manner as the diaphragm on barometer or aneroid capsules. The diaphragms may be made of sheet metal, which are suitably corrugated in accordance with the required expansion. If the diaphragms are of circular form the corrugations are preferably in the shape of concentric circles. The diaphragms may also consist of non-metallic resilient material, such as rubber or the like.

The pressure vessel may also consist of a sack made of flexible and extensible non-metallic material, which is surrounded by rigid sides, for example, of cylindrical form, provided that such material is sufficiently heat-resisting or that the sack is at all events fitted on to the door in such a position and is protected in such manner, that even in continuous use it will not let the pressure medium leak away.

The door locks associated with the pressure vessels are advantageously mounted on pins as is customary with locks hitherto used, and the usual spindle can be omitted, because the movement of the lock is effected by the pressure vessel. However, the hitherto customary spindle can be provided in the counter-abutment for the pressure vessel so that, when desirable, the necessary pressure adjustments to close and release the door may be manually effected without use of the pressure medium and pressure vessel. By providing a screw-threaded spindle, it is further made possible to adjust the measure of expansion of the pressure vessel.

With some types of pressure vessels it may be necessary or desirable to provide means for pressing back into their original positions the walls of vessels which have been bulged outwardly by the internal pressure to which they were subjected in the door locking operation. To this end, a counter-abutment for each locking bolt or bar, together with the latter and with the associated locking means, may be suspended in pendulum fashion above the corresponding locking plane, and in such manner that the center of gravity of the suspended parts is farther away from the door than is the suspension axis. On releasing the pressure medium in the associated pressure chamber, the pendulum-like suspended parts swing toward the door, whereby the previously expanded pressure vessels are automatically collapsed and the locks are thereby released.

When the locks are being adjusted by hand, no pressure is maintained in the expansible vessel and the counter-abutment may be supported by the walls of the pressure

vessel when these walls are rigid, or by the walls which surround the expansible vessel. In the use of a door having a plurality of locking units, it is possible to arrange for the maintenance of different pressures in different locking units. For this purpose, the expansible vessels respectively individual to the different units, may each be connected to a separate pressure supply pipe provided with a separate cutoff valve. Also, the surface areas of the expansible vessels which are exposed to internal pressure and form parts of the different locking units, may differ in order that different pressures may be applied to the individual locking units while the pressure in the supply pipes is equal.

As a rule, each expansible vessel mounted on a coke oven door should be subjected to the full internal pressure during the full operating period of the corresponding coke oven. However, an additional device in the form of a wedge or spring under tension may be employed to firmly hold the door in the position which it reaches when subjected to the door locking pressure, so that the sealed joint between the door and door frame remains tight even though the pressure in the expansible pressure chamber diminishes. Moreover, when such a door retaining device is employed, the expansible vessel may be put under pressure solely for the purpose of producing the necessary door tightening pressure, and in such case, shortly before the door is unlocked, the retaining wedge or spring must be released or removed. To this end, when the pressure in the expansible vessel has been released after the door locking operation, the pressure in the vessel is re-established so that the retaining device may be readily removed or freed, after which the pressure medium is again released.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

Of the drawings:

Fig. 1 is a front elevation of a coke oven door and doorway;

Fig. 1*a* is a diagrammatic illustration of a modification of the apparatus shown in Fig. 1;

Fig. 2 is a horizontal section on the line II—II of Fig. 1;

Fig. 3 is a front elevation of a portion of the door shown in Figs. 1 and 2 at the level of the upper door lock and with the lock spindle removed;

Fig. 4 is a plan view partly in section through the axis of the door lock shown in Fig. 3;

Figs. 5 and 6 are views taken similarly to Figs. 3 and 4, respectively, and illustrating a modification;

Fig. 7 is a front elevation of a portion of a door including an upper lock of modified construction;

Fig. 8 is a central vertical section through the door portion shown in Fig. 7;

Fig. 9 is a central vertical section through, and

Fig. 10 is a front elevation of the upper portion of a door having another locking arrangement.

In Figs. 1 and 2, I have illustrated a desirable embodiment of the present invention in a coke oven door arrangement in which the conventional cast iron door body comprises a base plate **1** and an outwardly projecting rim rib **2**; the door body **1** supports a fire-proof masonry body or plug **4** through clamping members **3**. The joint between the door body and the door frame **5** is normally sealed by means of a metallic sealing edge member **6** attached at **7** to the front side of the base plate **1** by a resilient plate **8** and adjustably pressed tightly against the door frame by set screws **9** which are mounted in small counter-abutments **10**. To lock the door in place, use is made of similar upper and lower locking units. Each locking unit is shown as including a separate locking bar or bolt **12**. The two bolts or locking bars **12** are interconnected for parallel rotative movements into and out of engagement with locking hooks **11**. The locking bars or bolts **12** are rotatably mounted on spindles **14** fitted in spindle nuts **15** for turning movements into and out of engagement with the hooks **11**. The latter are attached to the door frame **5** with one hook extending downwardly while the other extends upwardly, as is customary.

When the door is to be locked by hand, the operator puts a spanner on the square head **32** of the spindle **14** and turns the spindle in the tightening direction until the bolts exert a sufficient pressure on the door to ensure that the sealing edge **6** bears against the door frame **5** with sufficient pressure to establish a reliable seal between the door and door frame, provided the sealing edge **6** is adjusted correctly by means of the adjusting screw **9**.

The need for manually tightening the locks, which is especially laborious in the case of the upper lock, is eliminated in accordance with the present invention, by the omission of a rigid connection between the spindle nut **15** and the door body, and by the use of an expansible vessel interposed between the door body and the spindle nut or support **15**. When the expansible vessel is subjected to a suitable internal pressure, the bolts **12**, then in engagement with the hooks **11**, exert the required locking pressure on the door. The expansible vessels are connected to pipes **21** which may be temporarily connected, by means of a valve **22**, with a pressure medium supply pipe or header, or with a pressure generator or pump, not shown, after which the valve is shut and the connection with the pressure supply pipe or header, or with the pressure generator, is broken. Before releasing the locks, the valve **22** is opened and thus the pressure in the expansible vessels is released to enable the locks to be released.

In the arangements shown in Figs. 3 and 4, the walls of the expansible vessels are made of sheet copper, the inner base plate **16** bearing against the base plate **1** of the door body, whilst the outer base plate **17** of the vessel bears against the inner face of the spindle nut **15**, the latter serves as the outer abutment for the vessel. The cylindrical wall **18** is made like an accordion and permits expansion to take place in the direction of the axis of the lock. When the interior of an expansible vessel formed in this manner is put under pressure, the corresponding lock bolt **12** is pressed against the hooks. On releasing the pressure, the lock is released. Four ribs **19**, shown in Fig. 3, have claw-like ends guided by rails **20** on the door body, and support the spindle nut **15**.

In the arrangement shown by Figs. 5 and 6, the expansible vessel is in the form of a sack **29** made of elastic material instead of copper sheet. The sack **29** is enclosed between the inner face of the spindle nut **15**, a hollow cylindrical extension **23** of this nut and the outer wall of a dish-like intermediate plate **24**, within the extension **23** and having legs **25** bearing against the base plate **1**. Means are provided between the legs **25** and the base plate **1**, for protecting the sack **29** from heat radiation and conduction. For example, an asbestos plate **26**, or other suitable device, may be spaced from the base plate **1** as shown by distance pieces in Fig. 6. With this arrangement, heat transfer by conduction from the base plate **1** to the intermediate plate **24** and the extension **23**, is kept small. Heat transfer by radiation is likewise reduced by the asbestos plate **26**. In the arrangement shown in Fig. 6, hollow spaces are provided between the base plate **1** and the asbestos plate **26**, and between the asbestos plate and the intermediate plate **24**, through which the outer air can pass and serve as a cooling agent. Such provisions permit of the use of a material for the sack **29** which need not be able to resist extremely high temperatures. The locking of the door shown in Figs. 5 and 6 is effected by placing the sack **29** under pressure. If for some reason it is not possible to put pressure fluid into the sack, it is still possible to tighten the lock by hand, because after a number of turns of the spindle, the spindle nut comes to bear against the base plate **1** by means of the extension ring **23**.

In the arrangement shown in Figs. 7 and 8, a vessel made of sheet copper with end plates **16** and **17** and cylindrical bellows wall **18**, serves as the expansible vessel. Here, however, the arrangement is such, that on releasing the pressure in the vessel, an immediate loosening of the locking bolt on the spindle **14** from the door frame hooks takes place as a result of gravitational action. That action results from the fact that the spindle nut **15**, together with an inner circular extension **23** which surrounds the expansible vessel, is suspended by means of the arms **31** from a spindle **30** which is mounted in the lateral ribs **2** of the door body. As shown, the center of gravity of the load which pivots around the spindle **30** is disposed further outward from the door plate **1** than is the axis of the spindle. The spindle nut **15** thus

swings towards the door body as soon as the pressure in the expansible vessel falls.

In the arrangement shown in Figs. 9 and 10, the expansible vessel **35** is formed by a curved metallic base wall **32**, and a rubber disc **34**, which is fixed into the circular rim **33** of the base **32** and has its outer side in engagement with the inner face of the spindle nut **15**. In Figs. 9 and 10, the spindle nut is also suspended in such manner that the lock bolt moves away from the hooks as soon as the pressure in the vessel **35** falls. As shown, a hollow space **36** and an asbestos plate **37**, form a screen, as in the arrangement shown in Fig. 6, protecting the expansible vessel against heat transmitted from the inner parts of the door. When it is desirable, as it may be in some cases, the locking pressure developed by the expansible chambers mounted on a door body at different levels and connected to a common source of fluid pressure, may have different cross sectional areas. Thus as shown diagrammatically in Fig. 1*a*, the outer wall **17***a* of an upper pressure vessel to which the upper end of the pipe **21** is connected, may have a slightly greater cross sectional area than the pressure vessel **17***a'* to which the lower end of the pipe **21** is connected. Each of the expansible chambers **17***a* and **17***a'* may be similar in form to the expansible chamber shown in Fig. 4.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

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

1. In a door arrangement of the known type comprising a door body adapted to be removably mounted in a door frame having door holding elements attached thereto and having a sealing surface and comprising a sealing element attached to said door body and arranged to bear against said sealing surface and door locking means mounted on said door body for movement toward and away from the latter into and out of locking engagement with said door holding elements, the door locking improvement comprising a hollow, expansible, fluid tight vessel mounted on said door body and having its wall formed by rigidly connected parts at least some of which are relatively movable, said vessel being interposed between said door body and locking means and being arranged to create and release a door locking force acting between said body and said holding elements to releasably lock said door to said door frame when fluid under pressure is passed into said vessel, and a valved conduit connection to said vessel for passing fluid under pressure into said vessel to create said locking force and lock the door, and for releasing the pressure in said vessel to eliminate said force and unlock the door.

2. A door locking improvement as specified in claim 1, in which the portion of the expansible vessel wall extending parallel to the direction of the locking pressure force can be elongated.

3. A door locking improvement as specified in claim 1, in which the expansible vessel is of cylindrical form with its axis parallel to the direction of the locking pressure force.

4. A door locking improvement as specified in claim 1, in which the wall of said vessel includes corrugations with the side walls of the corrugations elongated in directions transverse to the direction of the locking pressure force.

5. A door locking improvement as specified in claim 1, comprising parts supported by said door body and arranged to prevent outward bulging of the outer wall of the expansible vessel.

6. A door locking improvement as specified in claim 1, in which said expansible vessel comprises a rigid wall portion parallel to the direction of said locking pressure force and comprises a flexible wall section transverse to said direction.

7. A door locking improvement as specified in claim 1, in which the expansible vessel comprises one or more wall sections in the form of a corrugated sheet metal diaphragm.

8. A door locking improvement as specified in claim 1, in which the expansible vessel comprises a wall section transverse to the direction of the locking pressure force in the form of a non-metallic flexible diaphragm.

9. A door locking improvement as specified in claim 1, in which the expansible vessel comprises one or more flexible diaphragm sections.

10. A door locking improvement as specified in claim 1, in which said flexible vessel is in the form of a sack made of flexible material and enclosed on all sides by rigid walls relatively movable in the direction of said locking pressure force.

11. A door locking improvement as specified in claim 1, comprising an abutment member mounted on the door body between the expansible vessel and the door locking parts and formed with a threaded socket and a threaded spindle extending into said socket and supporting the door locking parts, whereby the latter may be manually moved into and out of engagement with said holding elements to thereby lock and unlock the door.

12. A door locking improvement as specified in claim 11 comprising rigid parts mounted on the door body for engagement by said abutment and preventing injurious contact of the latter with the flexible walls of said vessel.

13. A door locking improvement as specified in claim 1, comprising an abutment between the expansible vessel and said locking parts and means for suspending said abutment with freedom to oscillate about an axis laterally displaced from the central portion of said abutment so that on a decrease in the pressure in the expansible vessel, said abutment moves toward the door body in a pendulum-like manner and thereby collapses the expansible vessel and unlocks the door.

14. A door locking improvement as specified in claim 1, comprising means interposed between the door body and the expansible vessel providing insulation against heat transfer by conduction to said vessel and screening the latter against heat radiation from the door body, thereby making it possible to use an expansible vessel having its wall formed by non-metallic elastic material.

15. A door locking improvement as specified in claim 1, in which the door body is provided with a plurality of door locking units each including an individual expansible vessel with a valved connection thereto, whereby the pressure locking forces created by the different expansible vessels may be independently regulated.

16. A door locking improvement as specified in claim 15, in which the different expansible vessels have different cross-sectional areas transverse to the direction of thehir respective locking forces.

17. A door locking improvement as specified in claim 1, in which said expansible vessel has its entire wall formed by integrally connected metallic parts.

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