No. 858,594. PATENTED JULY 2, 1907.

C. GAUSE & P. CONRADY.

CLOSING DEVICE.

APPLICATION FILED SEPT. 22, 1906.

2 SHEETS—SHEET 1.

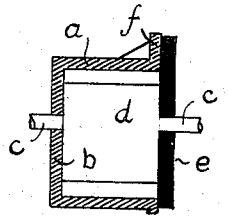

FIG. 1.

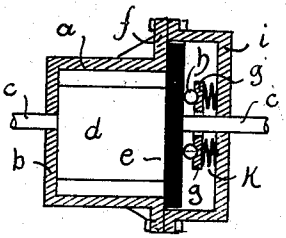

FIG. 2.

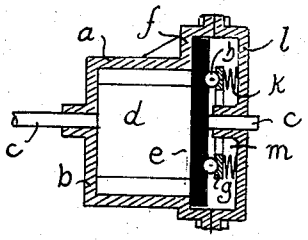

FIG. 3.

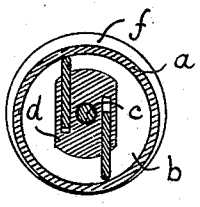

FIG. 4.

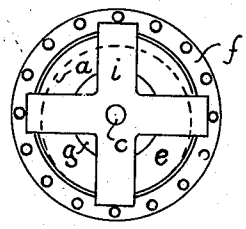

FIG. 5.

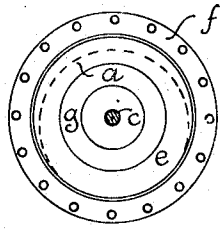

FIG. 6.

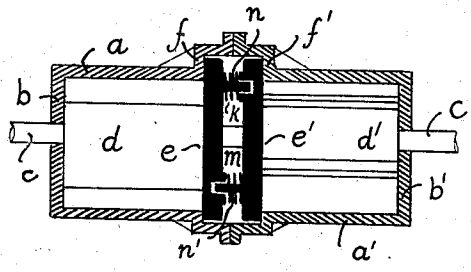

FIG. 7.

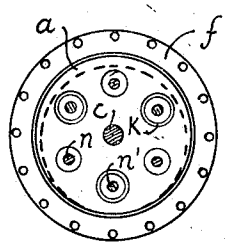

FIG. 8

WITNESSES

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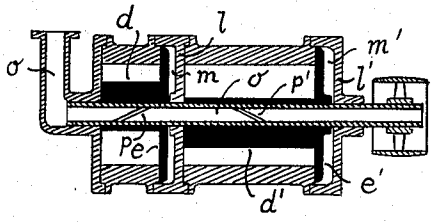

FIG. 9.

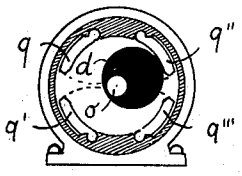

FIG. 10.

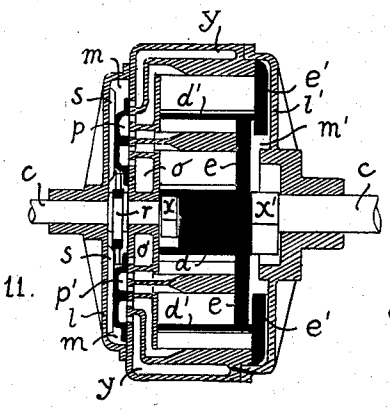

FIG. 11.

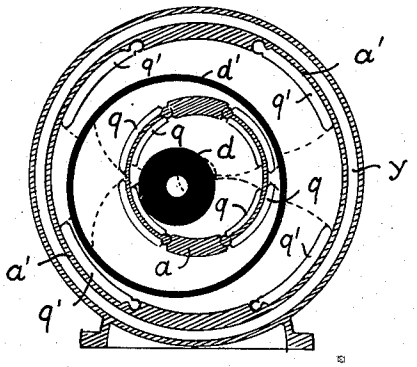

FIG. 12.

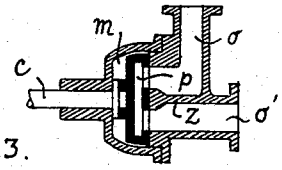

FIG. 13.

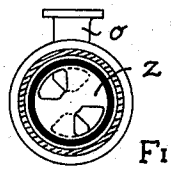

FIG. 14.

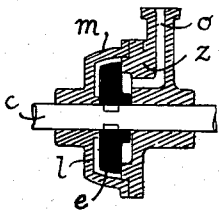

FIG. 15.

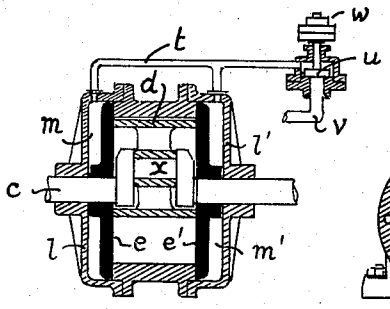

FIG. 16.

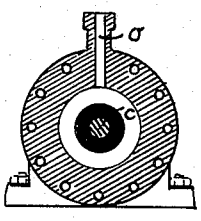

FIG. 17.

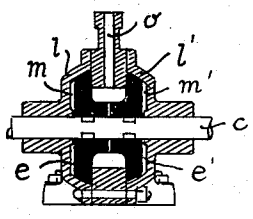

FIG. 18.

WITNESSES

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UNITED STATES PATENT OFFICE.

CARL GAUSE AND PHILIPP CONRADY, OF BERLIN, GERMANY.

CLOSING DEVICE.

No. 858,594. Specification of Letters Patent. Patented July 2, 1907.

Application filed September 22, 1906. Serial No. 335,828.

To all whom it may concern:

Be it known that we, CARL GAUSE and PHILIPP CONRADY, subjects of the German Emperor, residing at Berlin, Germany, have invented new and useful Improvements in Pressure-Eliminating Closing Devices for Use in Apparatus of Various Kinds, of which the following is a specification.

The present invention relates to improvements in pressure-eliminating closing devices for use in apparatus of various kinds.

It is already known in the manufacture of certain machines, of which the essential parts consist of a body (piston) situated in a rotating casing (cylinder), to tightly close the end surfaces of the rotating body against those of the piston by the cylinder only possessing at one side an end firmly connected with it, while the other end which closes the cylinder is not firmly connected with this, but is firmly connected with the piston which is not rotating, so that accordingly the cover is in this case formed by a disk on which the open front side of the cylinder is sliding. There were however difficulties in suitably equalizing the pressure existing inside the cover as naturally an additional pressure from within had to be entirely avoided, but also an additional pressure from without had not of course to be too strong. These difficulties were particularly perceptible owing to the pressure in the cylinder constantly changing, corresponding to the position of the piston or cylinder at any time. In order to remedy this it has already been proposed to have the real cover overlapped by a second cover, whereby the outer cover was to be tightly closed in optional manner against the rotating cylinder. Further, the inner cover was provided with grooves which were placed against the outer cover, so that a number of chambers were thereby formed between the two covers which should be connected each by means of a special opening with the interior of the cylinder. It was thereby attained that in each part of this intermediate space the same pressure existed as in the corresponding parts of the cylinder. This arrangement had however practically several disadvantages, especially that the inner cover had to be tightly closed again not only with respect to the cylinder, but also with respect to the outer cover, so that hereby considerably increased friction was produced, and also the manufacture of the entire apparatus was exceedingly complicated. Many difficulties were occasioned by the presence of numerous separated spaces which were only connected by means of narrow openings with the cylinder, as these small channels were not accessible and accordingly were easily exposed to the danger of being stopped up.

It is also not possible to tightly close parts of engines rotating in a casing, at least as soon as these have a considerable diameter, in such a way that quite independent disks are situated on the shaft passing through them, which disks are pressed by the steam pressure against fixed rings arranged in the casing or against any kind of packing. Rings of this kind easily become oblique and then prevent the machine running quietly. Also they cause the rotating part of the machine to be worn and no longer to fit tightly. Hence the purpose which is desired to be obtained by the joint is again not attained. If these rings are arranged, as has already been proposed, instead of as described, in such a way that they allow the passage of the rotating part of the machine with a certain amount of play, the arrangement of a special packing is necessary, whereby again those advantages are lost which should result from the use of a joint held closed solely by the steam pressure and working without special packing.

In accordance with the present invention the parts of the engine rotating in the casing carry a disk which is likewise rotating, said disk serving as the inner cover for the one end of the casing. Further the casing carries at the same end an outer cover, through which the rotating axle is allowed to pass, and inside which the inner cover rotates on the proper casing, and thus closes the latter. There are no perforations in the inner cover in any direction; also no packing of any kind is used for the joint which is made with the help of the inner cover.

A certain longitudinal displacement is permitted to the rotating part of the machine on the shaft rotated by it, so that with an increase of the pressure existing in the cylinder as opposed to that which exists in the cover-space, the interior cover is lifted off its seat for a moment. Hereupon the propellant flows into the intermediate space between both covers until there is an equal pressure at both sides of the inner cover, whereupon the cover is then pressed fast again on to the end surface of the casing. If a less pressure exists in the interior of the concerned apparatus than atmospheric pressure, as, for example, in suction pumps, the outer pressure of the atmosphere is sufficient to maintain the cover and piston in their reciprocal positions. A special outer cover is not then necessary for this purpose.

More particularly the present invention consists in improved joints suitable for use with various engines and other apparatus, an equalization of pressure being effected by means of sliding disks, and in order that the details of construction and action of our invention may be more clearly understood, reference is made to the accompanying drawings in which several forms are given by way of example, and in which:

Figures 1, 2 and 3 are vertical sections of engines with various forms of joints, and Figs. 4, 5 and 6 are end elevations of the same respectively, Fig. 4 being a section; Fig. 7 is a longitudinal section through another form, and Fig. 8 is an end elevation of the same; Figs. 9 and 10

are a longitudinal section and cross-section respectively of another form; Figs. 11 and 12 are a longitudinal section and cross-section respectively of another form; Figs. 13 and 14 are longitudinal and vertical sections respectively of a joint as applied in a valve; Fig. 15 is a longitudinal section through a bearing in which a joint is employed. Fig. 16 is a longitudinal section of another form of engine with a plurality of joints; Figs. 17 and 18 are cross-section and longitudinal section respectively of another form of bearing in which a plurality of joints are present.

Similar letters of reference refer to similar parts in all views.

Such a form of apparatus, in which a pressure less than that of the atmosphere exists in the interior of the same, as in suction-pumps, is shown in Fig. 1, in which *a* denotes the sides of the cylinder and *b* the ends of the same.

c is the shaft round which the rotary parts *d*, which are shown diagrammatically, rotate. *e* is the cover firmly connected with the latter which slides on the end surfaces of the cylinder *a* or on a flange *f* connected with it. The openings for the inlet and outlet of the fluid which moves through the apparatus are not shown in these and the following figures, as also all other parts which do not require to be directly considered for the purpose of the present invention.

If a pressure above that of the atmosphere exists inside the apparatus, as will generally be the case, or if the pressure below that of the atmosphere existing in the apparatus is not so considerable that the excess of the atmospheric pressure above this can serve with certainty to tightly close the cover, special devices are necessary for pressing the cover and piston together. Especially in the case last mentioned, suitably arranged springs are particularly adapted as such devices, as is shown in Fig. 2 in longitudinal section. Fig. 5 shows an outside view of the end cover of such a cylinder. The special manner in which such springs are preferably arranged is to be described in the specification in connection with Figs. 2 and 6. The said springs differ according to the purpose for which they are intended from springs arranged in similar cases, by their giving a supplementary pressure which is not the full amount of pressure which has to be taken into account, but only a certain pressure effecting a secure fitting of the cover.

In Figs. 2 and 5 the separate reference letters denote the same as in Figs. 1 and 4. Further, *g* denotes a ring arranged over the cover *e* around the shaft *c*, which ring is not firmly connected with the latter, and which runs on balls *h*, which latter are between it and the cover *e*.

i is a bow or strap fastened to the cylinder and extending over the cover *e* and the ring *g*. Between said strap and the ring *g*, springs *k* are arranged which press the ring *g* and thereby the cover *e*, without the ring participating in the motion of the cover.

As already remarked in the introduction it is however generally necessary to arrange a second outer cover *l* around the cover *e* in order to keep the cover *e* tightly closed, particularly when considerable excess of pressure above that of the atmosphere exists in the apparatus, said second cover being provided with flanges adapted to the cylinder *a*. A certain amount of space *m* remains between both the covers *e* and *l*, which space will hereafter be called the "cover-space." Now if a certain pressure in excess of that of the atmosphere exists in the cylinder, or rather in one of the spaces into which the cylinder is divided by the piston *d*, the cover *e* together with the piston *d* is raised up a little; part of the means causing the pressure in the space *m* will escape, but only until an equal pressure exists at both sides of the cover *e*. The cover *e* is then again pressed against the piston.

That in this case only a proportionately small part of the propellant requires to pass into the space *m* results from the following consideration: If an excess of pressure of 8 atmospheres above that of the atmosphere exists in the one of the two parts of the cylinder which are at the side of *d* and which has a clear cross-sectional area of 0.20 qm., and if, in the other one of the two parts of the cylinder at the side of *d*, with a clear cross-sectional area of 0.15 qm., no excess of pressure above that of the atmosphere exists, the cover *e* is, in this case, subjected to a pressure of $8 \times 2{,}000 = 16{,}000$ kg. from within.

If the upper surface of the cover *e* facing the space *m* has an area of 0.80 qm, an excess of pressure above the atmosphere of $16{,}000 \div 8{,}000 = 2$ atm. must exist here, in order to equalize a pressure of 16,000 kg. But this is only the fourth part of the pressure existing at the high-pressure side of the cylinder.

Moreover in practice the space *m* is always made as small as possible, so that the quantity of propellant which is necessary for filling it is hereby also reduced as much as possible. This effect can be still more increased by the space *m* being filled with a suitable inelastic liquid means, for example, with oil.

In order to assure an excess of pressure in the space *m*, with approximately small pressures existing in the spaces *m* and *a*, springs *k* are arranged inside the space *m* which engage, in similar manner as in the case of the forms previously described, on the one hand on the cover *l*, and on the other hand on a ring *g*. This latter, again, runs on balls *h*, so that it does not participate in the motion of the cover *e*.

One form of joint of the kind last described is shown in longitudinal section and cross-section through the space *m* in Figs. 3 and 6 respectively, the springs *k* which rest on the ring *g* not being shown in Fig. 6.

In order to maintain a suitable pressure in the space *m*, it may also be further arranged that it is connected with another space in which a certain medium pressure exists which, according to the example previously given, is, say, necessary, in order to maintain the pressure in *m* always somewhat greater than that in *a*. Thus a conduit, or the like, may be joined for this purpose to the space *m*, as shown in Fig. 16.

If several cylinders of the kind described are to be coupled with one another, they are preferably so placed against one another that, in the case of an arrangement corresponding generally speaking to Figs. 1 and 6, the covers *e* face one another. Then the arrangement of a special outside cover becomes superfluous, and the space *m* is formed by the intermediate space between the covers *e* and e^1. Such a form of the invention is represented in Figs. 7 and 8 in longitudinal and cross-section through the space *m* respectively. Both the pistons *d* and d^1 coupled one with the other are displaced 90° relatively to one another.

Hence it results that only the one of the two pistons, say *d*, requires to be firmly keyed on the shaft *c*, while

the other piston, here d^1, together with the cover e' fastened thereon, is only placed on the shaft c so that it drives the shaft c when it rotates, but is displaceable on c in the longitudinal direction. Both the plates e and e' are coupled together in a suitable manner permitting longitudinal displacement, for example, in the present form, by means of a number of pins n and n' one half of which are preferably fastened on the cover e, and the other half on the cover e' and engage in cavities of the cover which are opposite to them in each case. Moreover, in accordance with the forms already described, springs k are provided which are preferably arranged round the pins n and n'.

The advantage of the described joint lies in its always keeping tight. If it should happen that, in the rotation of the piston against the cylinder, the material of the same is ground away from the piston, the material is also ground away to an equal extent in the rotation of the cover e against the other end of the cylinder, so that the wear is equal at both sides and thus the close-fitting of all parts with one another remains continuously tight. Further, the piston does not either fit too tightly, nor does it run too loosely, so that neither too much friction nor slackness leads to drawbacks in working.

Figs. 9 to 18 give some forms by way of example for the practical application of the joint in accordance with the present invention; Figs. 9 and 10 show its employment in a rotary steam engine having two cylinders in longitudinal and cross-section respectively. This engine has two chambers to which steam is supplied through the pipe o and into which the steam enters through the valves p and p'.

d and d' are the rotary pistons carrying the covers or plates e and e', the manner of working of which is evident from the foregoing. It may be added that q, q', q'' and q''' are the flaps of clack-valves controlling the rotating piston of the one chamber.

The joint here described serves not only to equalize the pressures acting inside the working piston exercised by the fluids, but effects also the equalization of those axial pressures which originate from any cause outside the engine itself. As such causes may be specially mentioned those of machines which are coupled with rotary engines; also the effects of the screws of ships, and the resistances to be overcome by these, which make themselves noticeable in the form of axial pressure.

It is also to be noted that the arrangement here shown is not only usable for the case when both the piston-rotate inside the cylinder, the latter remaining stationary, but also for the case when the cylinder rotates and both the pistons are stationary. Further, it is to be noted, that also in other cases mentioned in this specification in which the like is possible, the same holds good; namely, the construction described may be used not only for rotating piston and stationary cylinder, but also for rotating cylinder and stationary piston.

Figs. 11 and 12 represent a rotary engine with several pistons situated one in another. Here the steam enters at o. p and p' are valves by means of which the distribution of the steam to the separate chambers is effected. These valves are likewise constructed according to the principle of the present invention, namely, so that the outer cover l is situated over the disks. The valves p are driven inside this space by an eccentric which is keyed on the engine shaft c. The outer cover l has, further, guides s for guiding the valves p and p'. By the valves p and p' being lifted up somewhat from their bearing surface with too powerful interior pressure, an equalization of pressure arises in the manner already described. Instead of filling the space m with propellants solely through the slit between the valve and the surface against it, it is also possible to connect this intermediate space m with the steam supply by a channel which has a reducing valve of the kind illustrated at u in Fig. 16, in such a way that a certain pressure always exists in m which is somewhat stronger than the average pressure acting from the interior spaces of the valves.

The mechanism proper of the rotary engine itself consists of the interior piston d which rotates in the interior cylinder a. This inside cylinder carries flaps q of clack-valves within and without which strike against the inner piston d, as well as against the outer piston d'. The latter is, with respect to the inner cylinder a, a cylinder, and with respect to the outer cylinder a' is simultaneously a piston. More valve-flaps q' are arranged within the latter. The steam entering through o goes in the first place into the intermediate space between the inner piston d and the inner cylinder a. From here it goes into the intermediate space between the outer piston d' and the inner cylinder a working here as piston. By the steam expanding again here still more, it goes then into the intermediate space between the outer piston d' and the outer cylinder a', and finally from there into the open air.

The inner and outer pistons d and d' are connected by the cover e to one whole. The cover e carries also the cover e' which slides on it. The inner piston d engages the shaft c of the apparatus by means of a crank x and x' and transmits to this the work done in the three spaces of the cylinder.

y is a steam-jacket for protecting the whole from cooling down.

Figs. 13 and 14 represent a steam valve made according to the same principle. Here the steam enters at o. The steam enters through the steam valve p which is controlled by the shaft c and passes into the conduit o'. The steam valve p plays the same part as the cover e in the forms previously described. The intermediate space between the covers is here formed by the valve p and by the valve-box cover l.

z is the valve-box proper.

Fig. 15 represents the employment of the principles here described in a bearing in which the load is supported by liquid under pressure. In this case c is the shaft which is journaled. e is the disk keyed on said shaft which is placed against the casing z. A suitable pressure-medium enters through the supply pipe o under the disk e. If the shaft is under a load such that the pressure or pull generally acts from the left to the right and so that the disk e is pressed against the bearing z, this one-sided pressure is completely cancelled by the pressure-medium acting from o, as the strength of the pressure acting from o is so proportioned that it is greater than the axial pressure. As pressure-medium enters into the intermediate space m between both the covers when there is a preponderance of the pressure of the liquid, a complete equaliza-

tion of pressure hereby takes place. Moreover, the advantage is also obtained, that if a suitable pressure medium is used, for example, oil, the excess of pressure-medium which escapes from the space n along the shaft serves for lubricating the bearing.

Fig. 16 represents a rotary engine which is distinguished by its having a cover not only on one, but on both sides, for the purpose of obtaining an entirely uniform wear of piston and cylinder at both sides. This engine forms, accordingly, a counterpart to the engine represented in Fig. 7, two different engines having a common cover-space and two covers joined with one another forming a united whole.

Further, a form is here represented, in which both the intermediate spaces m, m' between the covers are filled with a pressure-medium supplied from the outside. This pressure-medium enters, in the first place, through the conduit v into a reducing valve u which is suitably loaded by means of the weight w the effect of which is that only a certain pressure corresponding to the circumstances can arise in m, m', into which space it goes through the pipe t.

The remaining parts illustrated in the figure correspond to the parts contained in the engines previously described.

Figs. 17 and 18 show a bearing of a special kind which has to take up axial pressure both from the right and from the left hand. Such kinds of bearings are particularly for use for the shafts of ships.

The entire construction is similar to that shown in Fig. 15, only that instead of one disk e, two disks e, e' are present which naturally are placed facing one another.

What we claim as our invention and desire to secure by Letters Patent is:—

1. In apparatus adapted for various purposes, a pressure-eliminating closing device comprising in combination a stationary part, a part mounted revolubly relatively thereto with a space between the two, means adapted to normally close said space, supporting-means engaging said stationary parts, spring-pressed means engaging said supporting-means and said means closing said space, said latter means being adapted to normally close said space, when the pressure from without exceeds or is equal to that within said space, and adapted to move from said stationary part and disinclose said space only for a moment, when the pressure within said space exceeds that from without, whereby the re-closing of said space results from the elimination of the pressure which said space undergoes on account of the temporary parting of said parts from one another.

2. In apparatus adapted for various purposes, a pressure-eliminating closing device comprising in combination a stationary part, a part mounted revolubly relatively thereto with a space between the two, means adapted to normally close said space, means engaging said stationary part and inclosing said latter means having a space between the same, the two spaces being normally completely separated from one another by said former means, said former means being adapted to move axially relatively to said revolving part, whereby said spaces are connected and an equalization of the pressures existing in said spaces can take place.

3. In apparatus adapted for various purposes, a pressure-eliminating closing device comprising in combination a casing, a part mounted revolubly relatively thereto with a space between the two, a movable disk adapted to normally close said space, a cover engaging said casing and inclosing said disk in a second space, balls on said disk, a ring on said balls, springs engaging said ring and said cover, said spaces being normally completely separated from one another by said disk, said disk being adapted to move axially relatively to said revoluble part, whereby when the pressure in the cover-space is less than that in the former space, said pressures are equalized and the spaces are again separated from one another.

4. In apparatus adapted for various purposes, a pressure-eliminating closing device comprising in combination a cylinder, a piston mounted revolubly therein with a space between the two, a plurality of means adapted to normally close said space, means engaging said cylinder and inclosing said latter means having spaces between the same, said former space and said latter spaces being normally completely separated from one another by said former means, said former means being adapted to move axially relatively to said piston, whereby said former space and said other spaces are connected and an equalization of the pressures existing in said spaces can take place.

5. In apparatus adapted for various purposes, a pressure-eliminating closing device comprising in combination a cylinder, a piston mounted revolubly therein with a space between the two, a plurality of disks adapted to normally close said space, covers engaging said cylinder and inclosing said disks having spaces between each cover and each disk, said cylinder-space and said cover-spaces being normally completely separated from one another by said disks, said disks being adapted to move axially relatively to said piston, whereby said cylinder-space and said cover-spaces are connected and an equalization of the pressures existing in said spaces can take place.

In testimony whereof we have signed our names to this specification in the presence of the two subscribing witnesses.

CARL GAUSE.
PHILIPP CONRADY.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.