No. 641,825. Patented Jan. 23, 1900.

E. F. BOULET.

PISTON ROD PACKING.

(Application filed Dec. 31, 1897.)

(No Model.) 3 Sheets—Sheet 1.

Fig. XI

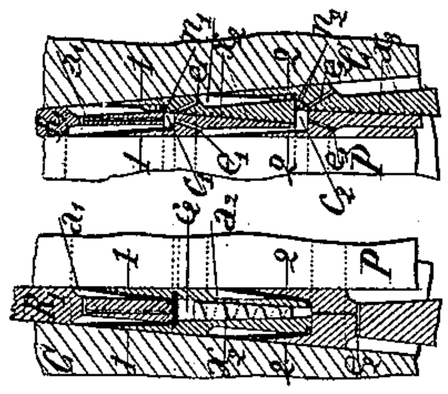


Fig. X

Fig. XIV

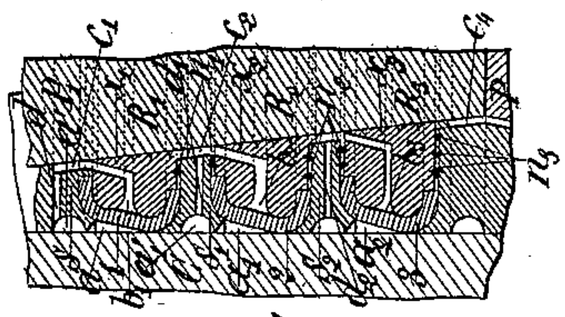


Fig. XIII

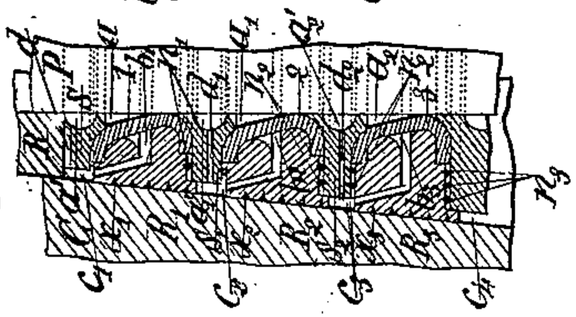


Fig. IX

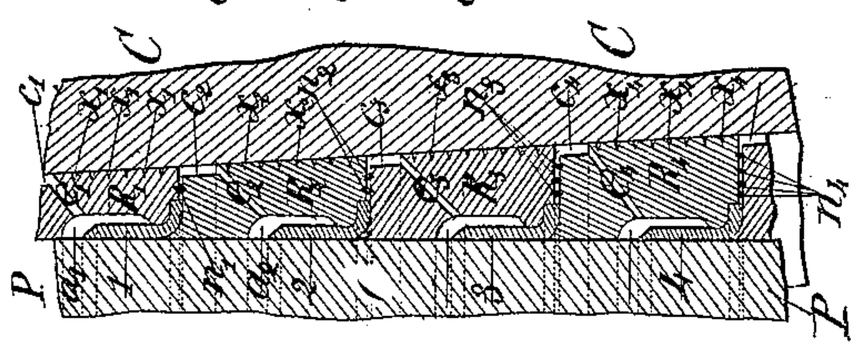


Fig. XII

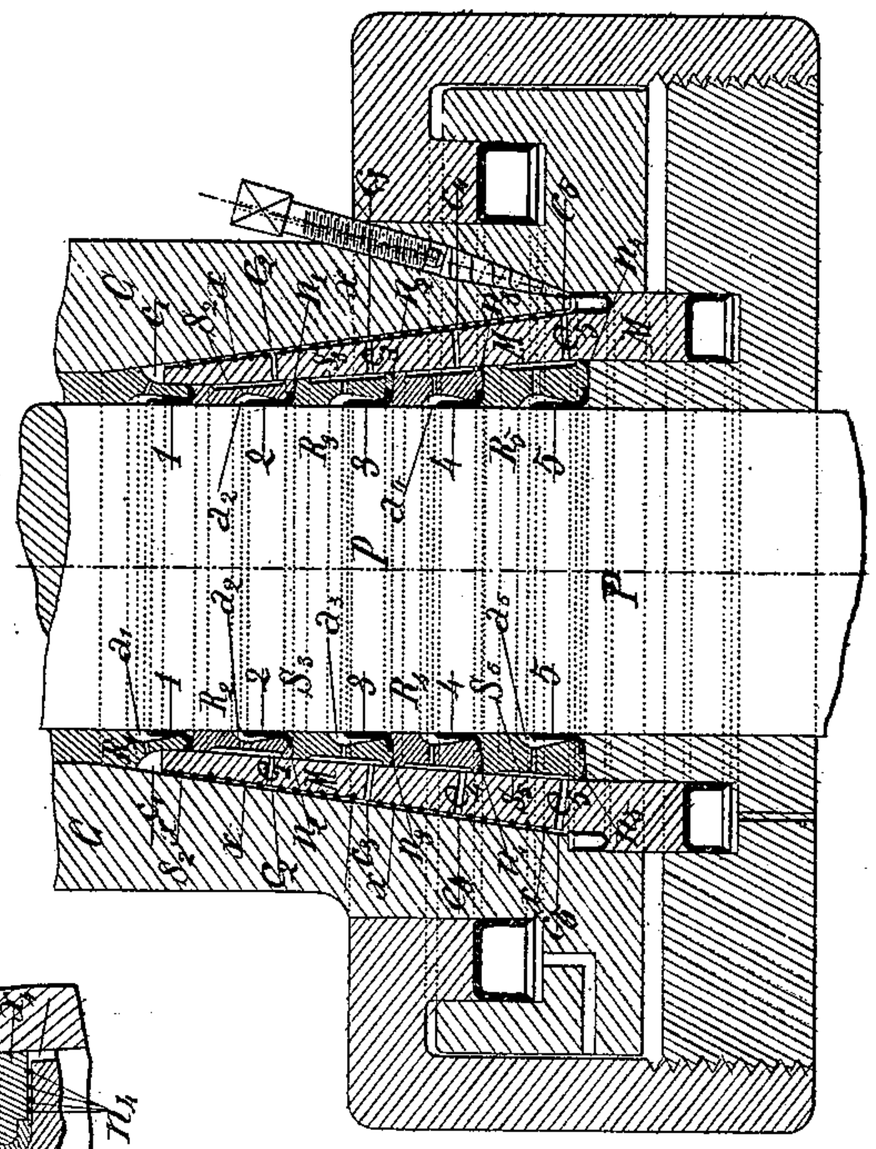


Fig. I

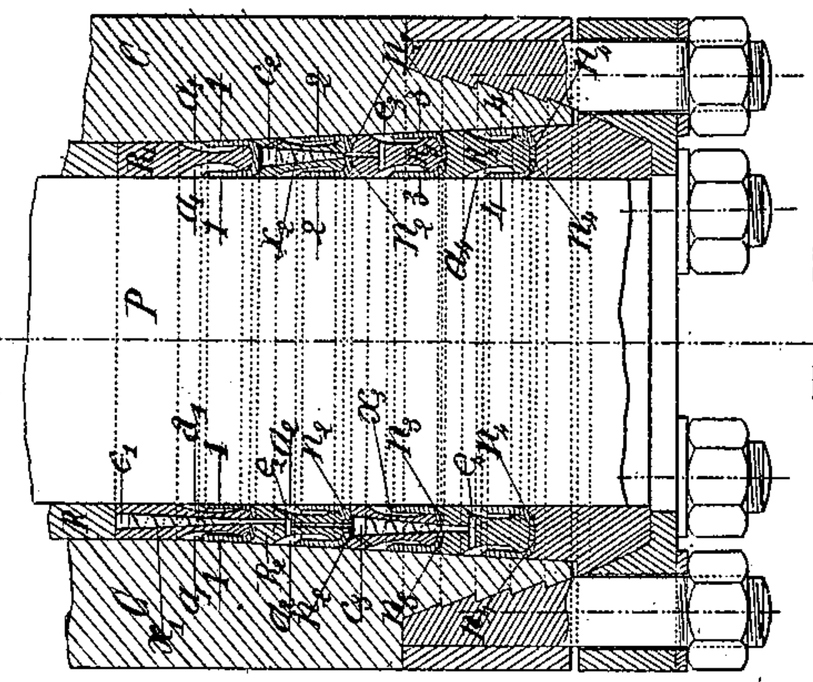


Fig. II

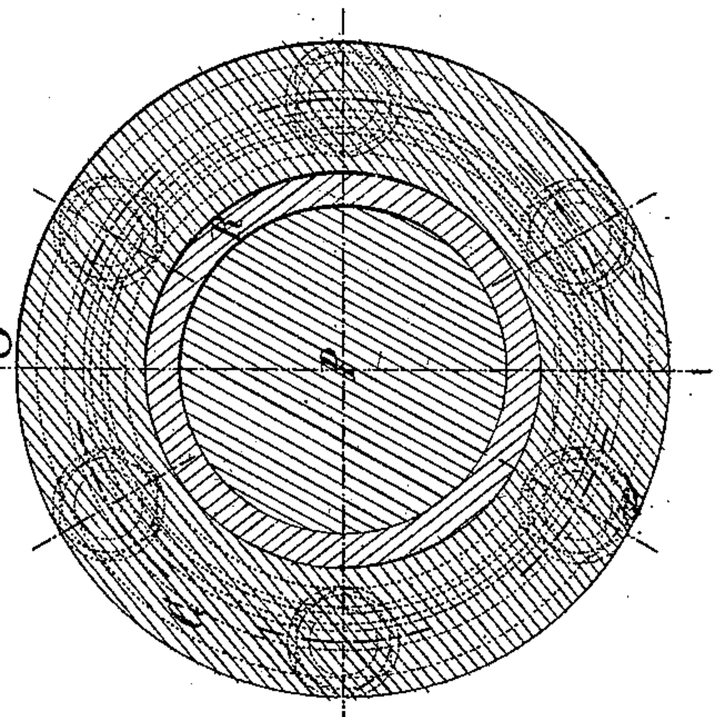


Fig. III

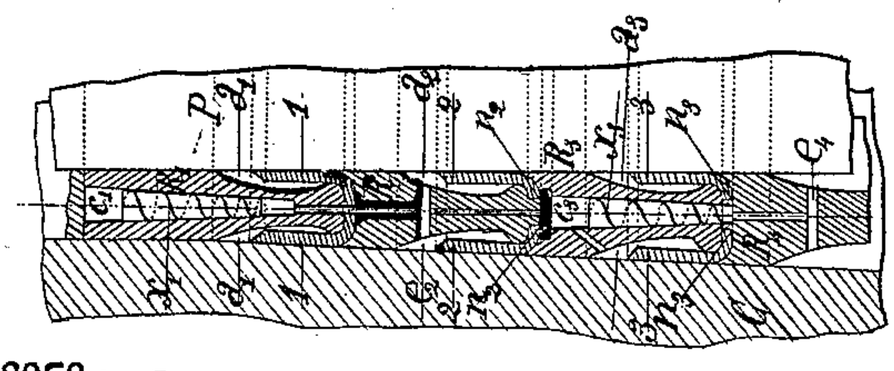
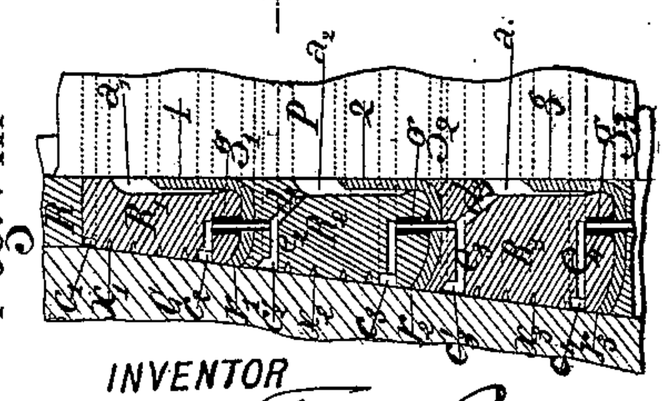


Fig. VIII



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E. F. BOULET.

PISTON ROD PACKING.

(Application filed Dec. 31, 1897.)

(No Model.) 3 Sheets—Sheet 2.

Fig. VI. Fig. VII.

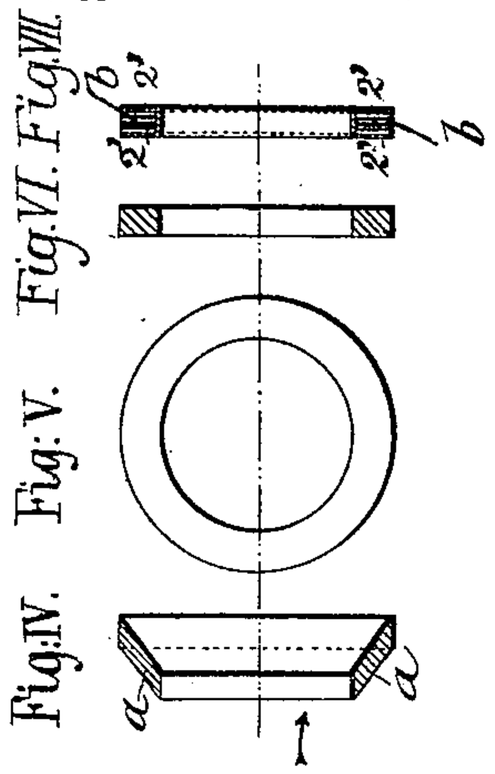


Fig. IV. Fig. V.

Fig. XVI.

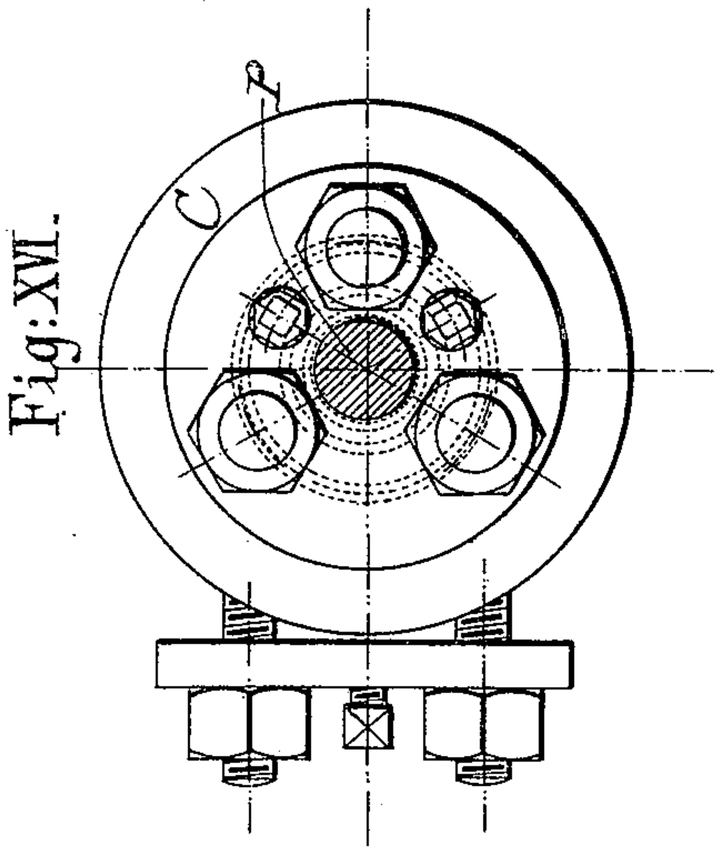
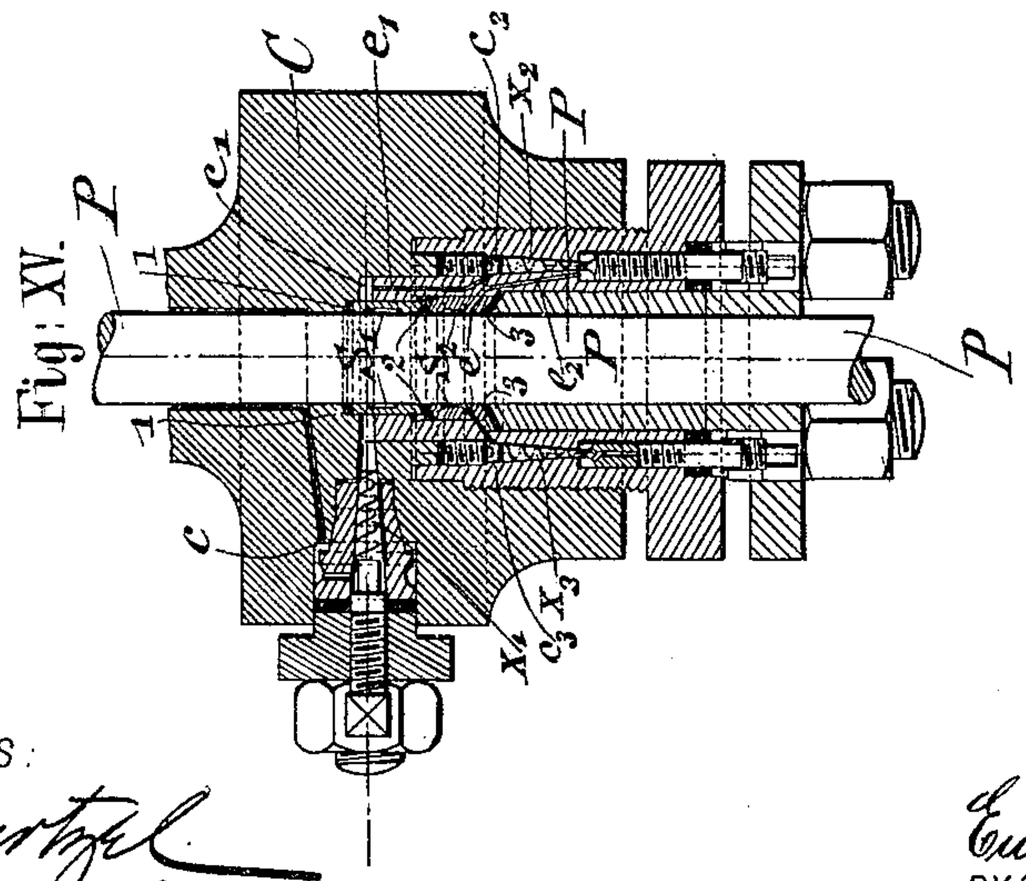


Fig. XV.



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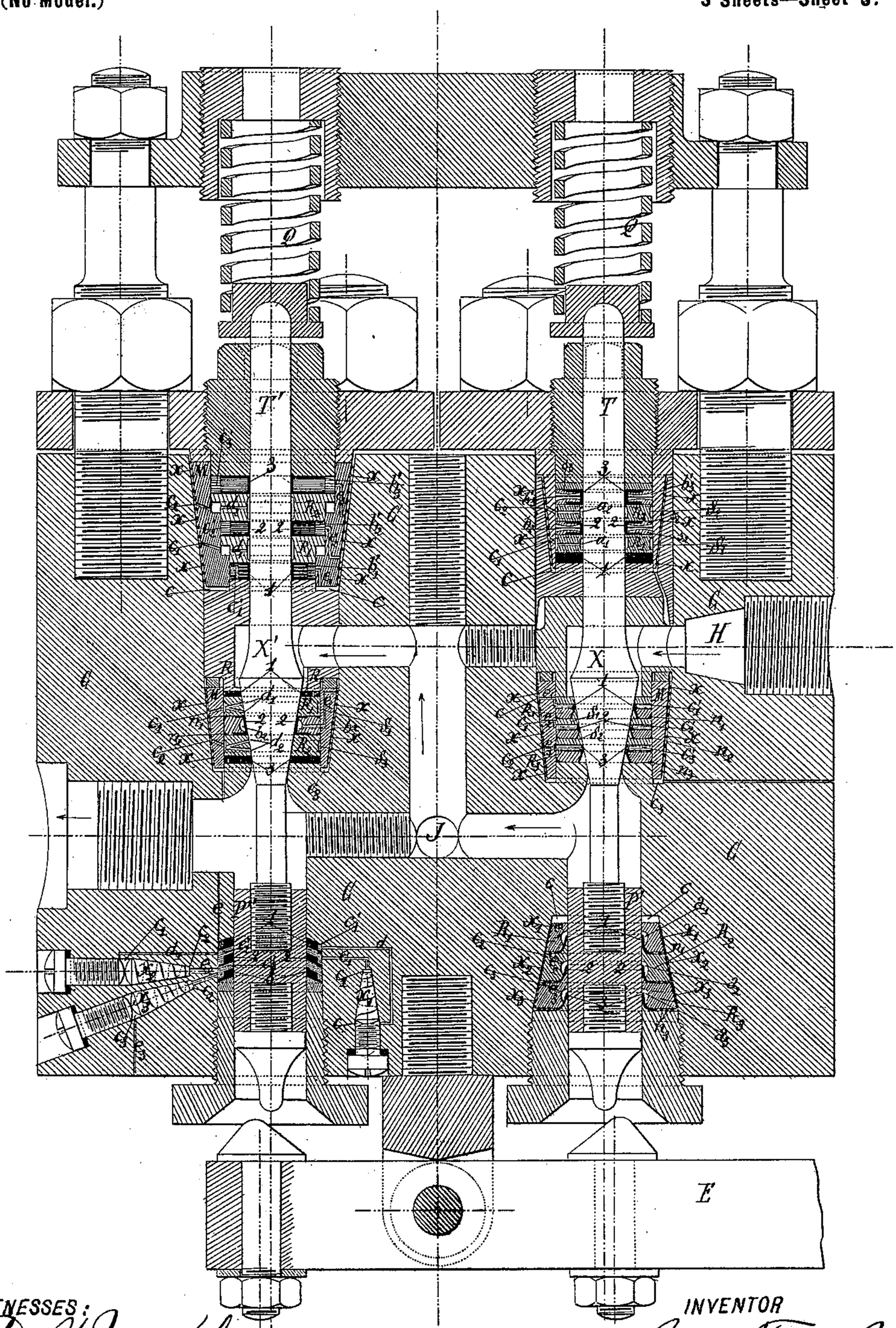

Fig. XVII.

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UNITED STATES PATENT OFFICE.

EUGÈNE FRANÇOIS BOULET, OF MONTLUÇON, FRANCE.

PISTON-ROD PACKING.

SPECIFICATION forming part of Letters Patent No. 641,825, dated January 23, 1900.

Application filed December 31, 1897. Serial No. 664,835. (No model.)

To all whom it may concern:

Be it known that I, EUGÈNE FRANÇOIS BOULET, a citizen of the Republic of France, residing at Montluçon, France, have invented certain new and useful Improvements in Piston-Rod Packings, (for which I have obtained Letters Patent in France, No. 234,758, dated December 18, 1893; in Belgium, No. 107,804, dated December 17, 1893; in England, No. 2,231, dated February 1, 1894; in Germany, No. 78,301, dated February 10, 1894, and patent of addition thereto, No. 84,635, dated May 21, 1895, and in Italy, Vol. XXVIII, No. 36,161, and Vol. LXXI, No. 31, dated April 13, 1894,) of which the following is a specification.

This invention relates to certain improvements in compound packings for piston-rods, valve-spindles, stuffing-boxes, &c., for highly-compressed fluids and gases, and particularly to packings of that class in which annular packing rings or elements are arranged separately from each other and in which the intervening space or spaces of the cylindrical surface which is to be packed or made tight is in direct contact with the fluid under pressure.

The packing is so arranged that each separate packing ring or element is pressed against the cylindrical surface which is to be packed or made tight with a different pressure from that exerted on the adjacent rings or elements—*i. e.*, in such a manner that the innermost packing ring or element is subjected to the greatest pressure and the adjacent rings up to the outermost to a gradually-decreasing pressure. Furthermore, the pressure fluid in the intervening spaces is under a gradually-diminishing pressure from inward to outward in succession, as the pressure in each intervening space is maintained at a fixed amount by the aid of special devices. Inasmuch as each packing ring or element on that side of it which is directed to the inner end of the piston-rod is in contact with a fluid of higher pressure than that of the fluid in contact with its end that is directed toward the outer end of the piston-rod, such element needs only to be made tight against a pressure representing the difference between the two fluid-pressures.

This invention is applicable also to the so-called "hydrostatic" packings—such, for instance, as leather packing or packing for glands and stuffing-boxes. In the former case the more highly compressed of the two pressure fluids in contact with the packing ring or element is utilized for the purpose of pressing such element against the surface to be packed and made tight, so that on the assumption that all the elements are of equal thickness it follows that each outer element in succession is pressed against the surface to be packed and made tight with a smaller pressure than the next adjacent element on the inner side.

The hydrostatic packing-rings must be supported against each other, and this may be done either by means of special annular rings or by a corresponding shape of the hydrostatic rings themselves. In the latter case the ring-shaped hydrostatic packing-rings may be formed with angular projections as substitutes for the special annular rings on the concave side—*i. e.*, toward the next preceding element—or on the convex-side—*i. e.*, toward the next following element.

In order to make the hydrostatic packing-rings—which, for instance, for high pressures are best formed in metal—equally tight for very low pressures, the concave surface of each packing-ring may be lined or covered with elastic material projecting slightly beyond the edge of the metal ring, so as to lie against the cylindrical surface to be packed or made tight. This internal elastic covering of the metal packing rings or elements may be secured between the metallic element itself and the supporting-ring, which may or may not be firmly secured to said metallic piece.

In hydrostatic packings for glands and stuffing-boxes a varying amount of pressure per square unit of surface to which the cylindrical surface to be packed and made tight is subjected by each packing ring or element is produced by the elastic packing-rings, which are subjected to the same pressure throughout the stuffing-box, having gradually-decreasing external diameters from the one end of the piston-rod toward the outer end of the same. In this manner the pressure which is produced by pressing down the gland acts upon annular plane surfaces of

elastic packing-rings of varying areas, and thus brings to bear in each a variable relative pressure per square unit of surface. At the same time the hollow annular space within the stuffing-box becomes larger in proportion to the contraction in the external diameter of the successive packing rings or elements by steps, as it were. This step-by-step decrease in the fluid-pressure in the intervening space between the packing rings or elements can be effected and maintained in various ways—such as, for instance, by means of valves.

For the hydrostatic packing elements there is another arrangement which may be recommended, in which the stay-rings (which may be cast in one piece with the metal bucket-shaped piece or separate therefrom) are made in two pieces—an inside and an outside one—of which the inner one carries a capillary helical groove running around the inner surface of contact between the two parts. With this arrangement the length of the capillary channel can be made extraordinarily great. One such arrangement which the inventor preferably adopts consists in connecting each intervening space with the one that precedes it, as well as with the one that follows it, and also, similarly, the innermost element with the inside of the cylinder and the outermost one with the atmosphere or a low-pressure accumulator by means of a capillary channel of very great length. In this manner a very small quantity of the fluid escapes from the cylinder through the packing rings or elements into the open air or into the low-pressure accumulator, passing from one intervening space to the next with a considerable diminution of pressure, owing to the great amount of friction developed in passing through the capillary channel. For instance, this may be so carried out that of two adjacent intervening spaces the one with the higher pressure is connected with the wide end and the other, which has the lower pressure, with the narrow end of a conical boring in which is arranged a conical valve-like plug, in the conical surface of which is cut a spiral groove of minute sectional area, running from one end to the other. These conical borings and plugs are well adapted for use in stuffing-boxes in the cylinder or gland, with hydrostatic packing-rings preferably in the element itself.

The employment of cone-shaped plugs, as described, has the advantage that they act as valves for the purpose of filling the intervening spaces and, if required, the cylinder. Fluid is introduced from outward to inward through the entire series of conical borings. A similar advantage may also be obtained with the divided stay-rings, with a spiral groove running around one of the dividing-surfaces, by making said surfaces conical, so as to employ one or the other of the divided parts in the same manner as the conical plug. The same effect may be obtained by a third arrangement, in which the biconical annular piece is fitted within the upper part of the undivided ring.

In carrying out the foregoing principles the invention consists, primarily, of a piston-rod packing provided with intervening spaces between two successive packing-rings, each space being filled with a fluid, the pressure of which decreases gradually with each intervening space from the high-pressure to the low-pressure end of the packing, said packing rings or elements being supported by stay-rings and pressed against the surface to be tightened with an intensity decreasing gradually in the same direction.

The invention consists, further, of certain details of construction, which will be fully described hereinafter and finally pointed out in the claims.

In the accompanying drawings, Figure 1 represents a vertical central section of a piston-rod packing constructed according to my invention. Fig. 2 is a horizontal section of the packing. Fig. 3 is a portion of the packing shown in Fig. 1 drawn on a larger scale. Fig. 4 is a detail vertical transverse section, and Fig. 5 a plan, of one of the packing-rings made of conical shape. Fig. 6 is a detail vertical transverse section of a packing-ring of rectangular cross-section. Fig. 7 is a vertical transverse section of a packing-ring for glands or stuffing-boxes, in which the packing-ring is made of U-shaped cross-section and filled with flat superposed packing-rings. Fig. 8 is a modified form of the packing shown in Figs. 1 and 3, showing the arrangement with spiral grooves in the outer surfaces of the stay-rings. Fig. 9 is a vertical transverse section of a packing in which the spiral grooves are likewise arranged on the outer face of the stay-rings, but in which the packing-ring in place of being made U-shaped is made angular or L-shaped and in which the stay-rings are separated by intermediate packing-rings. Figs. 10 and 11 are vertical transverse sections of two arrangements of packing-rings in which the concave surface of each packing-ring is lined with elastic material, Fig. 10 showing two separate rings for the wings of the stay-rings, while in Fig. 11 each stay-ring is divided into an outer and an inner section, which are tightly fitted together at their conical faces. Fig. 12 is a vertical transverse section of a piston-rod packing in which the entire core of packing-rings is not directly inserted into the cylinder, but arranged in a separate conical box which is inserted into a corresponding recess in the cylinder. Figs. 13 and 14 are vertical transverse sections of packings in which the packing-rings are clamped at their ends between the stay-rings, so that only a small portion of the rings is placed in contact with the piston-rod. Figs. 15 and 16 are respectively a vertical transverse section and a plan of a piston-rod packing in which valve-plugs are employed that are arranged in special boxes in-

serted into the cylinder and which show a modification of my construction, and Fig. 17 is a vertical section showing the application of my principle to the valves and valve-spindles of a high-pressure valve-gear.

Similar letters and numerals of reference indicate corresponding parts throughout the figures.

Referring to the drawings, P represents the piston-rod, and C the cylinder. The packing-ring 1 1 is formed of U-shaped cross-section and fits tightly against the piston rod P, as well as against the cylinder C, while the packings 2 2, 3 3, and 4 4 are each made of two pieces of angular or L-shaped cross-section, as shown clearly in Figs. 1 and 3. Between the packing-rings 2 2, 3 3, and 4 4 are arranged stay-rings R^2 R^3 R^4, so that in the same manner as with the single packing-rings 1 1, of U-shaped cross-section, the tight fitting of the entire annular space between the packing-rings is obtained. The lower ends of the stay-rings R', R^2, R^3, and R^4 are enlarged or thickened, so that only a comparatively small ring-shaped portion of the surface of the packing-rings is actually in use when the packing-ring is given such a diameter that in its natural position it would not hug directly the surface to be packed. By this arrangement is prevented the crowding up and forming folds of the wing of the packing-ring which presses against the piston-rod, by which crowding an increase of friction would be produced. The diminution of the hydrostatic pressures in the spaces between the packing-rings is produced by means of cone-valves x' x^2 x^3, (shown in Figs. 1 and 3,) which are provided with spiral grooves on their surfaces and which valves close up almost entirely the connecting-channels between two successive interior spaces. The channels are tightly packed at the point of connection between one stay-ring and the adjacent one, so that the liquid under pressure cannot enter to the tightly-clamped parts of the packing-rings. Through the packing-ring 1 1 extends a small tube, which is soldered into the stay-ring R' and tightly set into the base of the next adjacent stay-ring R, Fig. 3. The ends of the packing-rings 1 1, 2 2, 3 3, 4 4 are capable of free motion in the annular spaces or chambers a' a^2 a^3, which are formed between the stay-rings R' R^2 R^3 R^4 and the piston-rod at one side and between the stay-rings and the cylinder at the other side. The thickened surface of the stay-ring R' bears directly against the packing-ring 1, while the ends of the stay-rings R^2 R^3 bear on collars n^2 n^3, which are interposed between the sectional packing-rings 2 2 and 3 3. The pressure of the packing-ring 1 1 upon the next following stay-ring is transmitted upon the annular wings n^2 n^3 of the following stay-rings and transmitted to all the rings and packings below the same, so that it is sometimes necessary to increase the thickness of the rings so as to resist the gradually-increasing load. The decreasing pressure which acts on the packing-rings is regulated from one packing-ring to the other by means of the capillary channels which are formed by the spiral grooves of the cone-valves located in the stay-rings R' R^2 R^3, &c. The fluid is received at its maximum pressure on the packing-ring 1 1, flows then to the packing-ring 2 2, and so on from packing-ring to packing-ring until it is conducted off to the outside of the packing. While the fluid passes through these capillary channels of the cone-valves x' x^2 x^3, &c., it meets a resistance due to the friction in said channels, which gradually decreases; but in order that this gradually-decreasing pressure shall take place the fluid must be able to pass away to the outside of the packing, either into the atmosphere or into some receptacle. These capillary channels may be formed in other ways than by means of spiral grooves on the cone-valves; but the latter are preferred on account of the facility with which they can be produced.

Fig. 4 shows a section, and Fig. 5 a plan view, of a conical packing-ring, and Figs. 6 and 7 are respectively vertical transverse sections of an ordinary packing-ring and of a modified form of packing-ring employed by me. The conically-shaped packing-ring has the advantage over the ordinary packing-ring (shown in Fig. 6) that even after considerable wear of the same by the pressure of the fluid thereon the edge of the packing will still press against the piston-rod, so that the tight packing of the same is retained. Fig. 7 shows a packing-ring in section, which consists of an exterior portion of U-shaped cross-section and a number of interior superposed rings. The latter are formed of substances of different degrees of elasticity and in such a manner that the more elastic ones are located in the center. If such a packing-ring is pressed together by the cover of the stuffing-box, the packing-ring is pressed at the middle with greater pressure against the piston-rod, while the pressure diminishes gradually toward both ends. For small diameters of piston-rods the manufacture of packing-rings of leather or other substances can be made only with considerable difficulty, and it is therefore best to prepare the rings in the following manner: A straight strip of U-shaped cross-section is first cut, and both legs of this strip are pressed into corrugated form, which corrugated form disappears by bending the piece in circular shape. The strip is then again corrugated, and then again bent into a circle of smaller size, and so on until a closed ring is formed from the strip. The ends are then cut off obliquely, so as to overlap each other. On gluing them together the packing-ring can be used for hydrostatic packings, such as shown in Figs. 13 and 14, and for the packing shown in Fig. 17.

Fig. 8 illustrates an additional modification of my improved piston-rod packing. In this case the capillary channels x x' x^2, &c., are

arranged on the exterior surface of the stay-rings R, while the annular chambers a' a^2 a^3 are located adjacent to the piston-rod. To connect the channels of one stay-ring to the channel of the next adjacent packing and stay ring, it is necessary to introduce small tubes g' g^2 g^3. The packing-rings are angular in shape, only their inner wings serving for packing the piston-rod, while the packing for the cylinder C is obtained by the outer ends of the packing-rings, which are tightly clamped between the stay-rings similar to stuffing-box packings. Channels d^2, e^2, d^3, e^3, and e^4 connect the tubes g' g^2 g^3 with the chambers a' a^2 a^3 on the piston-rod side and with channels c^2 c^3 c^4 on the cylinder side of the packing.

Fig. 9 shows still another arrangement. In this construction the capillary channels x' x^2 x^3 x^4 are also arranged in the outer surface of the stay-rings R' R^2 R^3, but the outer bent ends of the packing-rings are shortened, so that the chambers c^2 c^3 c^4 can be connected directly with the inner chambers a' a^2 a^3 a^4 by short channels e' e^2 e^3 e^4. In this case, however, it is necessary to put between the adjacent faces of the stay-rings a packing which serves for the double purpose, first, of preventing the end pressure to pass to the face end of the packing-ring, and, secondly, of facilitating the tight connection of the outer surface of the stay-rings with the cylinder C. These packings are indicated by letters n' n^2 n^3 n^4 in Fig. 9, and a gradually-increasing number of them are arranged from the stay-ring R' to the stay-ring R^5, so that on the tightening of the cover or lid first the packing n' between the stay-rings R' and R^2 is compressed and the stay-ring R^2 tightly pressed against the cylinder, while by the additional tightening of the cover the packings n^2 between the stay-rings R^2 and R^3 are compressed, and thereby the ring R^3 tightly pressed against the cylinder, and so on.

Figs. 10 and 11 show two arrangements in which the concave surface of each packing-ring is lined with elastic material. In Fig. 10 two separate packing-rings 1 1 2 2, &c., are arranged at both sides of the stay-rings 1 2, &c., and are secured by pinching their inner edges between the adjacent surfaces of the stay-rings. In Fig. 11 each stay-ring is divided into an outer section and an inner section, which are tightly fitted together at their conical faces, so as to allow the inner section to be lifted along the outer section. At the conical faces of the inner sections spiral grooves x' x^2 x^3 are cut out for the same purpose as the spiral grooves in the cone-valves heretofore described. The tapering wings of each stay-ring are held in their places by the lower end of the adjacent stay-ring, the inner upon the inner line of the inner section and the outer upon the outer line of the outer section.

Fig. 12 shows the construction of a packing in which the packing-rings correspond to some extent with those shown in Fig. 9. The packing-cone in this case, however, is not located immediately in the cylinder, but is arranged in a conically-tapering box M, which is fitted with its still greater exterior conical surface into the cylinder C. The spiral grooves x' x^2 x^3 are located on the exterior surface of the box M and are connected by channels e^2 e^3 e^4 e^5 in the wall of the box with the inner annular chambers a' a^2 a^3 a^4 a^5 and the chambers c' c^2 c^3 c^4 c^5 between the stay-rings, piston-rod, and cylinder. In place of fitting the box so exactly into the cylinder C that the liquid under pressure can only circulate in the cross-sections of the spiral grooves there is a wire wound around these grooves, which is compressed by the forcing in of the box into the cylinder, so that the spiral grooves are filled up, but in place of the same, between the adjacent convolutions of the wire and the surfaces of the piston-rod and cylinder, another capillary channel of rectangular cross-section is obtained. This kind of capillary channel can also be supplied to the stay-rings shown in Fig. 9. At the inner face of the box M the tight fitting of the stay-rings R can be accomplished in any desired manner. Between the stay-rings R' R^2 it is accomplished by the compressed inner end of the packing-ring 1 1, while on the bottom portions of the other stay-rings small annular packing-rings n' n^2 n^3 n^4 are employed. The box M and the packing-cone may be tightened together by the same cover. In Fig. 12, however, mechanism is shown by which both can be individually adjusted. The cover presses directly on the packing-cone and is tightened by an L-shaped surrounding sleeve, which engages by its inner portion the flange of the cylinder C where it presses against a U-shaped packing-ring, which is subjected to high pressure in connection with an annular piston-ring and a fluid-supply channel below the same. On the outer cylindrical end of the conical box M presses an annular piston-ring, which is subjected to high pressure by a similar fluid-supply channel. The fluid under pressure, which passes between the conical box M and the cylinder C by the capillary pressure-regulating channel, is taken up by an annular channel and conducted from the same to the low-pressure accumulator or by means of a conical valve B, provided with spiral outlet-grooves and an axial bore in its stem, to the atmosphere. The assembling of the packing shown in Fig. 12 has to be very carefully attended to, as the pressure with which the packing-cone is forced on its seat is diminished by the entrance of the fluid under pressure correspondingly, so that, for instance, the tightening which is due to the spiral channel is lost when the wire has not a sufficient degree of elasticity. It is therefore advisable to use for the box M a metal of considerable strength, but of a greater degree of elasticity than that used for the cylinder C. The box M can thus follow the expansion of the cylinder C, which is

produced by the hydrostatic pressure, with sufficient force, so as to keep the wire in the grooves *x* under pressure and secure thereby the proper packing of the box. This object is properly secured if for the box M an elastic red metal is employed and for the cylinder cast-iron or for the box M steel, with a considerable addition of nickel, and ordinary steel for the cylinder.

Fig. 13 shows a packing in which the packing-rings are at the upper and lower ends retained firmly by the stay-rings, so that only a very small contact-surface between them and the piston-rod is obtained. Two adjacent stay-rings are separated by intermediate separating-rings S S′ S^2, &c., which transmit by means of channels *d d′* d^2, &c., the pressure from the outer surface of the packing-rings to the inner surface of the same.

Fig. 14 shows a packing similar to that shown in Fig. 13, but with the packing-rings arranged adjacent to the cylinder C and not adjacent to the piston-rod, as in Fig. 13. The lowermost separating-ring acts as the piston-cover, which takes the place of the cover in the packings heretofore described.

Figs. 15 and 16 show a special form of piston-rod packing, in which the cone-valves *x′* x^2 x^3 are not located directly in the cylinder C, but in special boxes *c* c^2 c^3, of which the latter two inclose at the same time the packing-rings more especially. For loosening and tightening the conical valves *x′* x^2 x^3 in case a closing up of the capillary channels of the same should take place and the cause thereof should be removed by a current of fluid under stronger pressure tightening-screws are arranged, one of which is formed in one piece with the conical valve *x′*, while the others are formed separately therefrom. One of these tightening-screws is provided with a longitudinal bore extending through its whole length, so that the outwardly-passing pressure-fluid can be conducted to the low-pressure accumulator or to the atmosphere.

Packings of the hereinbefore-described constructions cannot only be used for the pistons and piston-rods of pumps, power-motors, &c., but also for many other applications—as, for instance, for the packing of valve-spindles, of compressors, &c. Fig. 17 shows an arrangement in which different applications of my improved packing are shown as applied not only to the valve-spindles, but also to the valve-seats themselves. Some of the packings show a somewhat-different construction and are intended to serve only as examples of the various combinations of which my packings are capable. In the construction of the valve-seats for the valves X and X′ are employed packings with inclosing boxes M. The different packing-rings for the valve-seat X are elastic rings of conical shape, which are clamped at their outer ends between the stay-rings R and the intermediate packing-rings, while the intermediate rings are formed of rings of porous or other material through which fluid under pressure can percolate. In the valve X′ the middle packing-ring is constructed as a hydrostatic ring, according to the construction shown in Fig. 13, so that the pressure between the ends of the packing-ring is somewhat higher on one side than on the other. The valve-spindle T is provided with a cylindrical stuffing-box formed of three packing-rings, of which the two first ones are made according to Fig. 7. The stuffing-box of the valve-spindle T′ is made of a step-shaped stuffing-box, the individual packing-rings of which are likewise made according to Fig. 7, but with the difference that the exterior U-shaped packing-ring incloses besides the elastic rings an exterior porous ring through which the fluid under pressure acts on the elastic rings. In place of the porous ring a group of rings or segments with permeating joints can be used, or a ring of metal gauze or similar construction. The valves are operated by the oscillating lever E of the valve-gear, the thumbs of which lift the valve-spindles and produce thereby the working of the valves. This figure shows the application of a number of elementary principles contained in my different improved piston-rod packings and is a good illustration of the same. In this case the fluid or gas under pressure is supplied through the channel H and J and conducted off through the channel at the opposite side of the same.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. A compound piston-rod packing, composed of a plurality of packing-rings and stay-rings for supporting the same, said stay-rings and packing-rings being provided with intervening spaces or chambers communicating with each other and filled with a fluid, the pressure of which decreases gradually from one space or chamber to the other from the high-pressure to the low-pressure end of the packing, so that said packing-rings are pressed against the surface of the piston-rod with pressures decreasing in the same direction, substantially as set forth.

2. A compound piston-rod packing, consisting of a plurality of packing-rings, stay-rings for supporting the same, annular spaces or chambers intervening between the packing-rings and stay-rings, and channels communicating with said annular spaces or chambers so as to conduct a fluid under pressure from one chamber to the other, substantially as set forth.

3. A compound piston-rod packing, consisting of a plurality of packing-rings, stay-rings for supporting said packing-rings, annular spaces or chambers intervening between said packing-rings and stay-rings and between the stay-rings and the surface to be tightened, and channels in said stay-rings communicating with each other and with said annular spaces or chambers, substantially as set forth.

4. A compound piston-rod packing, consist-

ing of a plurality of packing-rings, stay-rings for supporting the same, annular spaces or chambers intervening between the packing-rings and stay-rings, main channels in said stay-rings communicating with each other, and lateral channels connecting the main channels with said intervening spaces or chambers, substantially as set forth.

5. A compound piston-rod packing, consisting of a plurality of packing-rings, stay-rings for supporting said packing-rings, said stay-rings being provided with capillary channels communicating with each other, annular spaces or chambers intervening between the packing-rings and stay-rings and the surface to be packed, and lateral channels connecting said capillary channels with said intervening spaces or chambers, substantially as set forth.

6. A compound piston-rod packing, provided with a plurality of packing-rings, stay-rings for supporting the same, annular spaces or chambers formed between said stay-rings and packing-rings and between the same and the surface to be tightened, longitudinal channels in said stay-rings communicating with each other, and lateral channels connecting said longitudinal channels with said intervening chambers, substantially as set forth.

7. A compound piston-rod packing, consisting of a plurality of packing-rings and stay-rings for the same, said stay-rings being provided with conically-tapering channels, and conically-tapering plugs located in said channels and provided with capillary channels on their surfaces, substantially as set forth.

8. A compound piston-rod packing, consisting of a plurality of packing-rings, stay-rings for the same, annular channels intervening between said stay-rings and packing-rings, channels in said stay-rings communicating with each other and with said annular channels, and an exterior box extending over all the stay-rings, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

EUGÈNE FRANÇOIS BOULET.

Witnesses:
GEORGES CHAPUIS,
JACQUES CONDOMET.