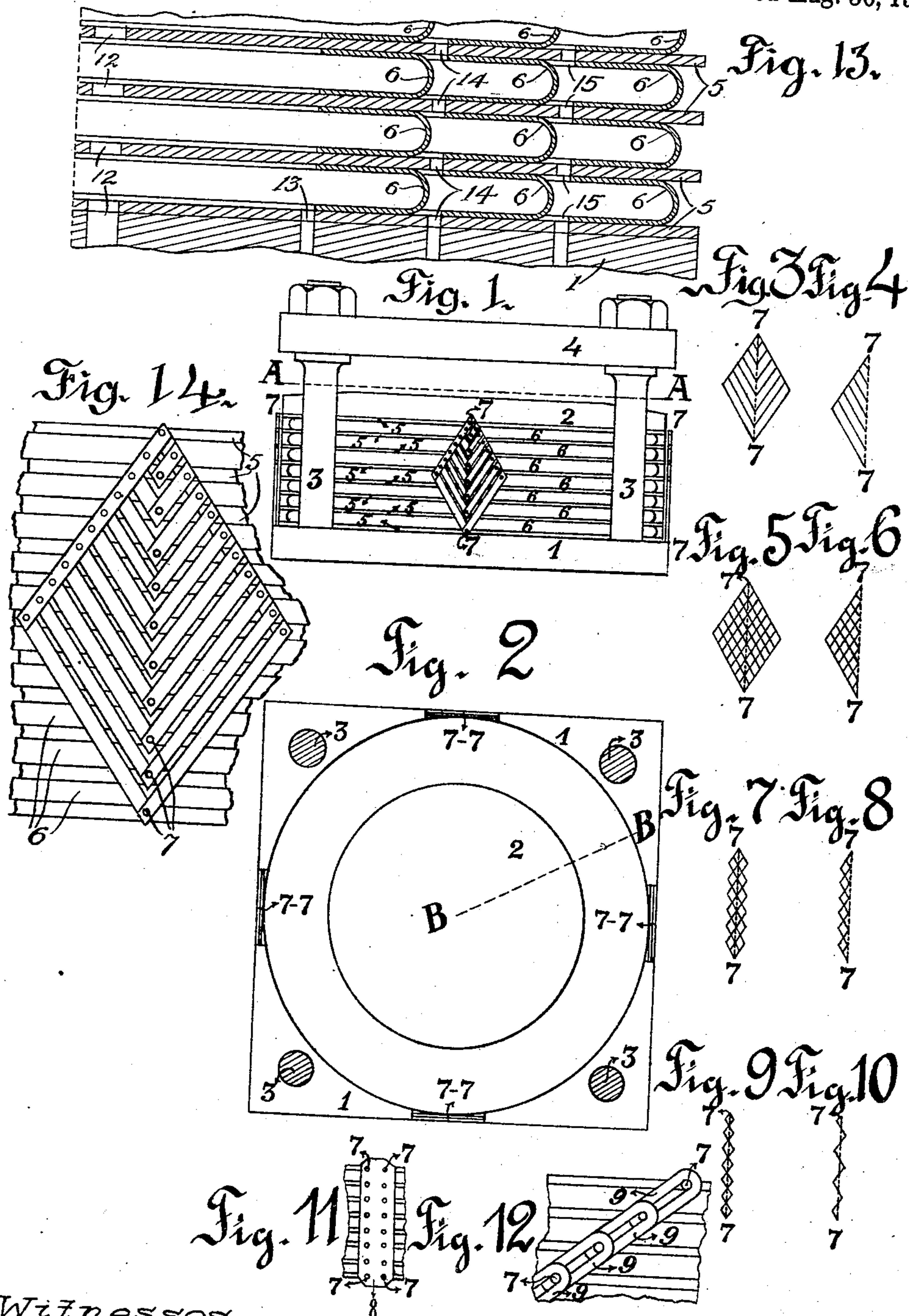


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 BELLOWS LIKE HYDRAULIC AND PNEUMATIC MACHINE AND APPARATUS.
 APPLICATION FILED FEB. 15, 1909.

968,642.

Patented Aug. 30, 1910.



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BELLOWS-LIKE HYDRAULIC AND PNEUMATIC MACHINE AND APPARATUS.

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Specification of Letters Patent. Patented Aug. 30, 1910.

Application filed February 15, 1909. Serial No. 478,084.

To all whom it may concern:

Be it known that I, PIERRE BRANDT, professor and engineer-colonel, subject of the Czar of Russia, residing at 5 Officer street, St. Petersburg, Russia, have invented certain new and useful Improvements in Bellows-Like Hydraulic and Pneumatic Machines and Apparatus, of which the following is a full, clear, and exact description.

In the construction of bellows-like hydraulic and pneumatic machines and apparatus the chief difficulty encountered is the attainment of proper strength of the side walls, more particularly if the top and bottom plates are curvilinear. In the latter case the flexible wall should have no surfaces of large radius of curvature considered in a vertical plane, otherwise the admissible pressure is comparatively small and the machine cannot be of high power.

Mathematical analysis shows that with any given dimensions the machine, for example a press, may be constructed for pressures of a considerable higher amount, if care will be taken that the curvature considered in a vertical plane of the flexible wall increases (*i. e.* the corresponding radius of curvature decreases) with increasing of the working pressure. This essential object of the invention can be attained by compelling the flexible wall to retain, when expanded, a corrugated or undulating shape. Several devices suitable for this purpose will be described hereinafter. The most simple method is to engirdle the bellows with hoops, the strength of which must depend on the maximum distance between their center lines, the diameter of the machine, and the intended pressure. The maximum admissible radius of curvature of the undulations to be produced at maximum expansion of the machine, can be determined with reference to the strength of the flexible wall. The strengthening members may either consist of single hoops or of helical rods. If a plurality of coiled strengthening members is used the members may be parallel or may cross each other. The flexible walls of the machine are either fastened to the top and bottom plates of the machine, or the pressure chamber may be an independent removable bellows, to the flat hermetic top and bottom plates of which the undulating cylindrical walls are connected.

The invention is illustrated in the annexed drawing as applied to a press.

Figure 1 is a side-view of a hydraulic or pneumatic bellows press, strengthened by metal hoops, showing the bellows fully expanded. Fig. 2 is a horizontal section on the line A—A of Fig. 1. Figs. 3 to 10 are schematical illustrations of strengthening arrangements of the bellows. Figs. 11 and 12 are detail views of the strengthening arrangements used in this invention. Fig. 13 is a sectional view of a modification of a press of the kind described. The plane of this section would be found on line B—B of Fig. 2. Fig. 14 is a detail view, showing parts illustrated in Fig. 1 on a larger scale.

The flexible wall 6 is connected to the press plate 2 and bed plate 1, the latter being connected by pillars 3 to the head plate 4. The flexible wall is engirdled by metal hoops 5. The guides for the press plate, the external guards, and the means for supplying the pressure fluid are not shown in the drawing. The stiffness of the material, of which the bellows is made determines the distance between the aforementioned hoops. If heavier hoops are used special means must be provided for the purpose of this regulation, in order that the curvature of the flexible cover be not reduced. If it is desired that the distance between the hoops remain uniform at all expansions, parallelograms of pivotally connected rigid rods may be connected to pins 7 fixed to the hoops 5 along vertical lines as shown in Fig. 1. These parallelograms may be complete or partial as shown in Figs. 3 to 10, the connections of the rods to each other and to the hoops being pivotal. The arrangement of the rigid rods diagrammatically illustrated in Fig. 3 is the same as that shown in Fig. 1.

In Figs. 3 to 10 schematical arrangements of the aforementioned parallelogram are illustrated. As it may be seen from Figs. 3, 5, 7, 9 and 10, it is possible to arrange the strengthening parallelogram symmetrical to an axis, which is parallel to the axis of the bellows, while in the arrangements, illustrated in Figs. 4, 6 and 8, no axis of symmetry is shown. Fig. 3 is a schematical view of the arrangement, shown in Fig. 1.

If exact uniformity of distances is not essential the pins may be joined together by a flexible connection, as for example shown in Fig. 11, where vertical rows of pins 7 are joined together by a wide strip of

leather 8. Separate chain links or the like 9 (Fig. 12) may be used for the same purpose, in which case the pins are not arranged along vertical lines but along helical lines running symmetrically in opposite directions in even numbers, in order to simplify the construction.

Fig. 13 is a section through a modified press, similar to but of stronger construction than the press shown in Fig. 2. The press is shown, while the bellows are in a state of partial expansion. The bellows resting on the bed plate 1 is provided with a plurality of strengthening members 5, preferably made of metal and comprises a flexible wall 6. The strengthening members may have the shape of disks, provided with apertures 12 for the passage of the pressure fluid. The concentric strips of which wall 6 is made up, are subjected only to the difference between the pressures on the opposite sides thereof. The distribution of the fluid and the equalization of the pressure in the several concentric chambers may be performed by means of pressure distributors and pressure regulators of the kind set forth in the application filed Sept. 14, 1908, Ser. No. 453,020. These devices communicate with the annular chambers by means of small holes 13, 14 and 15. This arrangement allows of constructing presses of very large diameter and for very high pressures.

With the construction last described the design of the press for a given pressure is independent of the diameter, so that theoretically the diameter may be infinite. This means that the circumference of the press may be prolonged with rectilinear or even with concave external surfaces.

I claim:—

1. In a bellows for hydraulic and pneumatic machines the combination of a flexible hollow body forming the wall of said bellows and means for maintaining said body in undulated shape, when a pressure fluid is admitted into the interior of said bellows.

2. In a bellows for hydraulic and pneumatic machines the combination of a flexible hollow body forming the walls of said bellows, means for maintaining said body in undulated shape and a means in co-action with said first named means for limiting the expansion of said bellows, when a pressure fluid is admitted into the interior of the same.

3. In a bellows for hydraulic and pneumatic machines the combination of a plurality of flexible strips in supra-position, each of said strips being closed in itself, and a plurality of rigid members, each of said rigid members being interposed between two of said flexible strips.

4. In a bellows for hydraulic and pneumatic machines the combination of a plurality of flexible strips in supra-position, each of said strips being closed in itself and a plurality of rigid members, each of said members being interposed between two of said flexible strips and being fastened thereto by means of adhesives exclusively.

5. In a bellows for hydraulic and pneumatic machines the combination of a plurality of series of flexible strips, each of said strips being closed in itself, said strips being in supra-position with respect to each other and said series being in concentric arrangement with respect to each other, a plurality of rigid members, each of said rigid members being interposed between superposed strips and being fastened thereto, said rigid members being provided with apertures registering with the annular interspaces between said strips.

In testimony whereof I have hereunto set my hand this 16th day of January, 1909, St. Petersburg, Russia, in the presence of two subscribing witnesses.

PIERRE BRANDT.

In the presence of:

H. A. LOVIAGUINE,
M. SKREYZKOWITZ.