Aug. 6, 1968 P. SCHRAMM ET AL 3,395,541

SHUT-OFF PLATES FOR CONTROLLING THE FLOW OF LIQUIDS

Filed Oct. 3, 1963

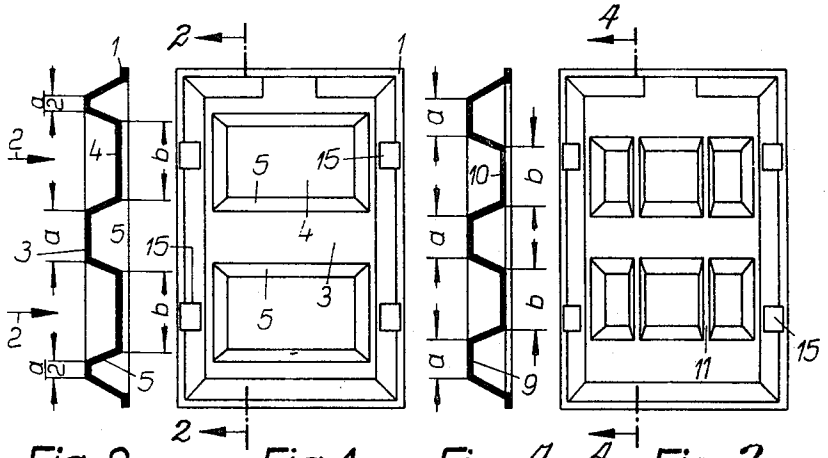

Fig. 2. Fig. 1. Fig. 4. Fig. 3.

United States Patent Office 3,395,541 Patented Aug. 6, 1968

3,395,541

SHUT-OFF PLATES FOR CONTROLLING THE FLOW OF LIQUIDS

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Filed Oct. 3, 1963, Ser. No. 314,589
Claims priority, application Germany, Oct. 5, 1962, P 30,306
5 Claims. (Cl. 61—28)

ABSTRACT OF THE DISCLOSURE

A pressure plate of cast iron for water gates includes a planar outer frame portion and an inner portion. The latter defines open recesses and intervening plateau areas, the recesses being in the shape of an inverted frustum of a pyramid and their open side co-extensive with the rectangular base of the aforementioned frustum of a pyramid.

This invention relates to shut-off plates for water gates intended to be used to control the flow of liquids, and in particular the flow of water.

Shut-off plates according to this invention are intended primarily in liquid control systems wherein a housing for the shut-off means is dispensed with. In such systems the shut-off plate is provided with driving means for moving the shut-off plate along a pair of guides or rails. The shut-off plate is associated with wedge means for clamping the plate against the aforementioned guides, or rails, when the shut-off plate is moved to the lower position thereof, to interrupt the flow of a liquid. The shut-off plate proper is generally provided with a frame structure surrounding the same and it is this frame structure which is being clamped against the aforementioned guides, or rails, to establish a relatively tight seal.

Conventional shut-off plates are generally relatively bulky. If made of cast iron they comprise re-inforcing ribs to preclude, or minimize, bending of the plates under the heavy pressure of water to which they are subjected, and to prevent leakage resulting from bending of the plates. If fabricated by combining steel sections gate plates are subject to corrosion and require high cost of maintenance.

Shut-off plates for sluices and the like are being made for various water heads such as four yards, six yards up to sixteen yards, and even more.

As a general rule, the aforementioned re-inforcement ribs are provided on the side of the shut-off plate opposite to the side acted upon by the pressure of water in order to preclude mud, fecies, and the like, from depositing on the re-inforcement ribs.

Generally re-inforcement ribs are arranged immediately adjacent to the edges of shut-off plates and thus the shut-off plates and their re-inforcement ribs define jointly a relatively shallow structure.

The aforementioned prior art shut-off plates have a relatively limited dimensional stability, in spite of their relatively heavy weight and great bulk. Even in the presence of re-inforcement ribs the bending, or deflection, to which prior art shut-off plates are subjected is quite considerable. A conventional prior art shut-off plate of cast iron having a width of about 32 inches and a height of about 40 inches has a weight in the order of 600 pounds, and is fractured if subjected along the center to about 22 metric tons, the area upon which this pressure is applied being equal to about 1.4 inches x 1.2 inches. The bending, or deflection, which occurs immediately prior to breaking of such a prior art shut-off plate is in the order of .7 inch.

It is, therefore, one object of the present invention to provide substantially planar shut-off plates which are not subject to the aforementioned drawbacks and limitations.

The relatively heavy weight of prior art shut-off plates requires particularly heavy machinery for operating the same such as, for instance, operating spindles and operating gears.

It is, therefore, another object of the present invention to provide shut-off plates which are not subject to the aforementioned drawbacks and limitations.

Other objects and advantages of this invention will become apparent as the following description proceeds, and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to, and forming part of, this specification.

Plates according to the present invention include a planar outer frame portion and an inner portion. The latter is uneven in cross-section rather than flat, i.e., the inner portion has a substantially uniform wall thickness and its vertical cross-section is undulating between flat valleys and flat ridges or plateaus. The pressure-receiving side or front side of the inner portion and the side thereof remote from the pressure-receiving side form trough-shaped recesses. The sum total of the areas of flat plateaus on the pressure-receiving side of the inner portion of the plate is preferably smaller than the sum total of the area of the flat plateaus of the opposite side of the inner portion of the plate.

FIG. 1 is a front elevation of a shut-off plate embodying the invention;

FIG. 2 is a vertical section along 2—2 of FIG. 1;

FIG. 3 is a front elevation of another embodiment of the invention; and

FIG. 4 is a vertical section along 4—4 of FIG. 3.

Referring now to the drawings, and more particularly to FIGS. 1 and 2 thereof, the plate shown therein is made of cast iron and has a rectangular outline. Reference numeral **1** has been applied to indicate a rectangular frame surrounding the plate proper. Frame **1** is intended to engage the slide surfaces, or guide surfaces (not shown) along, which the plate is movable to open, or to close, a given channel for liquids. Thus two opposite sides of frame **1** are intended to form sealing surfaces. The arrows **2** of FIG. 2 indicate the direction in which the pressure of a liquid, such as water, is acting upon the plate. In other words, the side to the left of FIG. 2 is the upstream side, and the side to the right of FIG. 2 is the downstream side. As clearly shown in FIG. 2 the surface of the plate is uneven and its vertical cross-section is undulating between flat valleys and flat ridges or plateaus. It is apparent from FIG. 2 that the line forming the vertical cross-section of this embodiment is made up of aligned trapezoidal shapes adding up to the aforementioned undulating geometry. Reference character **3** has been applied to indicate the strips or surface elements which are situated at the pressure-receiving side or front side of the plate, and reference character **4** has been applied to indicate the strips or surface elements which are situated on the side of the plate remote from the pressure-receiving side thereof. The parallel surface elements **3** and **4** are joined together to form a unitary structure by means of the slanting surface elements **5**. The strips or surface elements **3** on the pressure-receiving side have a width of $a/2$ and of a, respectively, and the width of the strips or surface elements **4** on the rear side of the plate is b. The sum total of the surface elements or strips **4** is $2b$ and the sum total of the surface elements or strips **3** is $2a$. The width $b=2a$. Therefore, the sum total of the areas of strips **4** is twice as large as the sum total of the

areas of strips 3. Generally the sum total of the areas of strips 4 should be larger than the sum total of the areas of strips 3. To be more specific, the sum total of the areas of strips 4 should be one times to four times as large as the sum total of the areas of strips 3. The areas of strips 3 and 4 are determined in such fashion that the stresses which occur at the front side of the plate and at the rear side of the plate are substantially equal. This is of particular importance when considering plates which are fashioned of cast iron capable of being subjected to substantially equal tensile stresses and compression stresses. It may be mentioned in this connection that comparable prior art plates are subjected to different stresses on the front side and the rear side thereof when under the action of a body of water.

In some instances it is desired to provide shut-off plates of which each of both sides can be subjected selectively to the pressure of a body of water, or other liquid. In such instances the width or aggregate area of the strips on the rear side of the plate and on the front side of the plate must be equal, and the plates must be designed to withstand the highest stresses which occur when acted upon on either side by a body of water, or other liquid.

The plates shown in FIGS. 1–4 are provided with re-inforcements **15** and re-inforcements **16** which are arranged immediately adjacent to the periphery of the plate. Re-inforcements **15** are acted upon by the wedge means normally used in connection with such plates and re-inforcements **16** are intended to be acted upon by the drive for the plates, i.e. to receive the drive spindles (not shown) for operating the plates.

FIGS. 3 and 4 illustrate a structure which is substantially identical to the structure of FIGS. 1 and 2. In the structure of FIGS. 3 and 4 the recesses formed on the front side and the rear side of the plates are sub-divided by transverse ribs, or fins, **11** into a plurality of sub-recesses.

The structure of FIGS. 3 and 4 differs also from that shown in FIGS. 1 and 2 in that in the former the width *b* of the strips or surface elements **9** on the rear side of the plate is equal to the width *a* of the strips or surface elements **10** on the front side of the plate.

The structures which have been disclosed above are conducive to a significant reduction in weight which may be in the order of 50%. Such plates can be subjected to higher pressures which may be 2 to 3 times as high as those to which comparable prior art shut-off plates may be subjected. Plates according to this invention show a much smaller degree of bending or displacement than comparable prior art plates and are easier to manufacture than comparable prior art plates.

The trapezoid shape of the vertical cross-section of the shut-off plates results in the formation of open recesses on the front side of the plates and the formation of open recesses on the rear side of the plates. The flat bottom portions of the recesses situated on the front side of the inner portion of the plate form the flat plateau areas of the inner portion of the rear side of the plate and the bottom portions of the recesses situated on the rear side of the inner portion of the plate form the flat plateau areas of the inner portion of the plate on the front side thereof.

It will be apparent from FIGS. 3 and 4 that the shut-off plate which is shown in these figures is trapezoid-shaped plate in several of its horizontal cross-sections, and the vertical cross-sections of the structure shown in these figures are a series of aligned trapezoidal figures.

It will be apparent from the foregoing that the planar frame **1** is rectangular and completely surrounds the inner portion of the pressure plate. The recesses in the latter are each in the shape of a frustum of a pyramid, or a truncated pyramid, each recess being surrounded by a substantially flat plateau area. This is true in regard to the upstream side of the plate and the downstream side thereof. All flat plateau areas of the upstream side are coextensive with the flat bottoms of the recesses on the downstream side, and vice versa. All flat plateau areas of the upstream side and all flat bottom areas on the downstream side are situated in a first common plane. All flat plateau areas on the downstream side and all flat bottoms of the upstream side are situated in a second common plane parallel to, but spaced from, said first common plane. As shown in FIG. 2 the aforementioned second common plane is slightly spaced in upstream direction from the plane defined by frame **1**.

As mentioned above, reference character **15** has been applied to indicate re-inforcements immediately adjacent to the peripheral portion, or frame portion, of the plate structure, their function being to transmit pressure to the plate structure to cause the latter to tightly engage its cooperating slide surfaces, or guide surfaces. To achieve this and re-inforcements **15** must necessarily be integral with the vertical peripheral elements of the peripheral portion of the plate structure or, in other words, re-inforcements **15** must be integral with the vertical elements forming the frame of the plate structure.

It will be understood that we have illustrated and described herein preferred embodiments only of the invention and that various alterations may be made in the details thereof without departing from the spirit and scope of the invention as defined in the appended claims.

We claim as our invention:

1. A pressure plate for water gates for controlling the flow of liquids across channels comprising in combination an outer peripheral planar frame portion including horizontal and vertical frame elements, and a trough-defining portion entirely inside said planar frame portion, said trough-defining portion being undulating in vertical cross-section between flat valleys and flat plateaus and having substantially trapezoid-shaped horizontal cross-sections, said trough-defining portion having an upstream surface and having a downstream surface each having a plurality of recesses with flat bottoms surrounded by flat plateau areas, said flat bottoms of all said recesses of said upstream surface and all said flat plateau ares of said downstream surface being situated in a first common plane, and said flat bottoms of all said recesses of said downstream surface and said flat plateau areas of all said upstream surfaces being situated in a second common plane parallel to said first common plane, and said planar frame portion and said inner trough-defining portion being formed of cast iron.

2. A pressure plate as specified in claim **1** including reinforcement ribs inside said recesses partitioning said recesses into a plurality of sub-recesses.

3. A pressure plate for water gates for controlling the flow of liquids across channels comprising in combination an outer peripheral planar frame portion including horizontal and vertical frame elements, and an inner portion entirely inside said planar frame portion, said inner portion having a substantially uniform wall thickness and being undulating in vertical cross-section between flat valleys and flat plateaus, said inner portion having an upstream surface and a downstream surface, both said upstream surface and said downstream surface defining recesses each having the shape of a frustum of a pyramid and each having a flat bottom, both said upstream surface and said downstream surface defining flat plateau areas surrounding said recesses, said flat bottom of each of said recesses of said upstream surface and each of said flat plateau areas of said downstream surface being situated in a first common plane, and said flat bottom of each of said recesses of said downstream surface and each of said flat plateau areas of said upstream surface being situated in a second common plane parallel to said first common plane, and said planar frame portion and said inner portion being formed of cast iron.

4. A pressure plate structure of cast iron for water gates for controlling the flow of liquids across channels, said plate structure comprising in combination an outer

peripheral planar frame portion including horizontal and vertical frame elements and an inner portion entirely inside said frame portion, said inner portion having a substantially uniform wall thickness defining on the pressure receiving side thereof a first plurality of open recesses having flat bottoms and surrounded by substantially flat plateau areas and said inner portion defining on the side thereof remote from said pressure receiving side a second plurality of open recesses having flat bottoms and surrounded by substantially flat plateau areas, the sum of the areas of said bottoms of said first plurality of recesses being larger than the sum of the areas of said bottoms of said second plurality of recesses, each of said first plurality of recesses and each of said second plurality of recesses being substantially in the shape of an inverted truncated pyramid having a rectangular base and being open at said rectangular base, each of said flat bottoms of said first plurality of recesses being situated in a first common plane and each of said flat bottoms of said second plurality of recesses being situated in a second common plane parallel to said first common plane.

5. A shut-off pressure plate for water gates for controlling the flow of liquids across channels, said plate including an outer peripheral planar frame portion defining a plane and having horizontal and vertical frame elements and an inner portion entirely inside said planar frame portion, said inner portion having a substantially uniform wall thickness and being undulating in the vertical cross-section between flat valley areas and flat plateau areas, said inner portion defining a first plurality of open trough-shaped recesses having flat rib-reinforced bottoms on the pressure-receiving side of said inner portion and

said inner portion defining a second plurality of open trough-shaped recesses having flat rib-reinforced bottoms on the side of said inner portion remote from said pressure-receiving side, said flat plateau areas on said pressure-receiving side of said inner portion surrounding said first plurality of recesses and being arranged in a first common plane with all said bottoms of said second plurality of recesses, said flat plateau areas on said side of said inner portion remote from said pressure-receiving side thereof surrounding said plurality of recesses and being arranged in a second common plane with all said bottoms of said first plurality of recesses, and said second common plane being parallel to the plane defined by said frame portion and offset in upstream direction from the plane defined by said frame portion.

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