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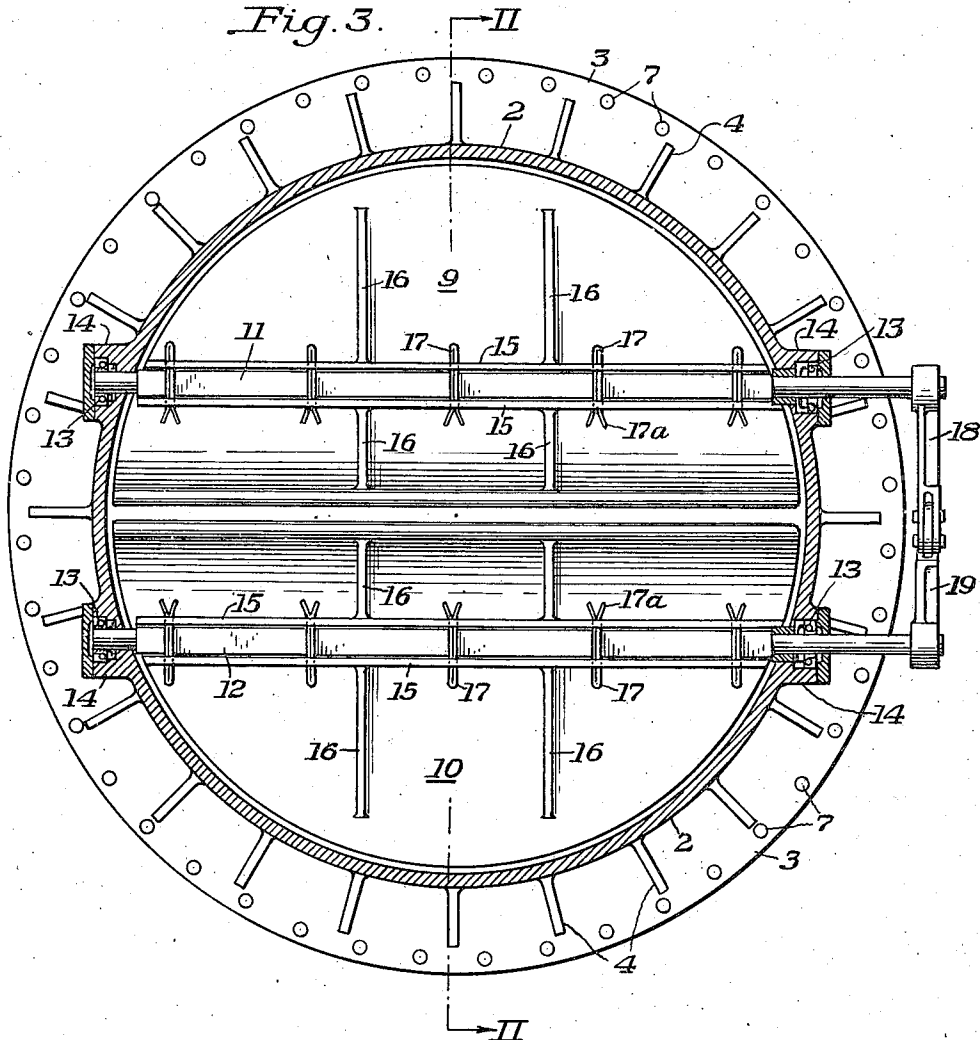
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BUTTERFLY VALVE

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2 Sheets-Sheet 2

Fig. 3.



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BUTTERFLY VALVE

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This invention relates to valves, and more particularly, though not exclusively, to valves for those industrial apparatus in which butterfly valves are normally used, and especially to valves used in conduits carrying high temperature gases.

The usual butterfly valve consists in a plate or disk having a peripheral outline substantially the same as the cross sectional form of the passage in which the valve is mounted to control the flow of fluid. The disk is rotatable on a diametrical axis, between a position in which the disk extends transversely of the passage and closes the passage to flow, and a position in which the disk extends on the longitudinal center line of the passage, leaving the passage substantially unrestricted to flow. The disk is adjustable to flow-controlling positions intermediate the two limits mentioned.

It will be understood that when the disk is in an intermediate position of adjustment the body of the disk is inclined to the axis of the passage, whereby the stream of fluid flowing in the passage is deflected by the inclined body of the disk, causing the stream to impinge against the wall of the passage. If, as is the case in numerous industrial installations, the flowing stream of liquid or gas contains particles of abrasive material, or by reason of its high temperature or composition is highly corrosive, the wall of the conduit on the downstream side of the valve is subject to the destructive action of the deflected stream of fluid, and sooner or later the wall of the passage is worn to destruction. This circumstance, manifestly objectionable in whatever field of industry it is encountered, is particularly serious in the steel industry, where large refractory lined conduits carry hot gases laden with particles of ash, slag, metal, or ore.

As a specific example, the flue that carries the outgo gases of a blast furnace may be cited. These gases are hot, and entrained in them are substantial quantities of finely divided iron ore, known as flue dust. The flue is constructed of plate steel, lined with refractory material to protect the steel walls of the flue. The gases contain large quantities of carbon-monoxide, and they are cleansed of flue dust and used as fuel for the air-preheating stoves, steam-generating boilers, or other fired equipment of the blast furnace plant. The conventional butterfly valve, provided to control the flow between the furnace and the gas washer or flue-dust precipitator, is instrumental in causing rapid erosion of the refractory lining of the flue under the impingement of the dust-laden gases, and it will be understood that in those instances in which the temperature

of the gases is relatively high, the refractory lining is rendered yet more vulnerable to the deleterious conditions.

The invention consists in the provision of a butterfly valve which in open or partially open position concentrates the flow of the stream of flue gases more nearly towards the center of the valve structure and the longitudinal axis of the flue, whereby the objection noted is eliminated, or is so far reduced as to be inconsequential. Whereas the conventional butterfly valve consists in a single wing or disk mounted to swing on a diametrical axis, the butterfly valve of this invention comprises a pair of complementary wings or disk members. The paired disk members are severally mounted to swing between open and closed positions, and in open or partially open position the disk members form a funnel-like passage that is aligned with the center line of the flue. Thus, the valve not only eliminates the objection noted, but also affords advantages readily to be appreciated by those skilled in the art.

The invention will be understood upon reference to the accompanying drawings, in which:

Figure 1 is a view in side elevation of a valve structure that embodies the invention;

Figure 2 is a view in medial and vertical section through the valve structure, with adjacent portions of the refractory lined flue in which the valve is included shown fragmentarily; and

Figure 3 is a transverse sectional view of the valve structure, on the plane III—III of Figure 2. The plane of section of Figure 2 is indicated at II—II in Figure 3.

The body of the valve structure here comprises an annulus or cylinder 2, having peripheral flanges 3 reinforced by means of angle webs 4. The body may be, and is here shown to be, cast integrally of iron or steel, and in the case of the exemplary blast furnace installation in mind, a cast steel of 12 per cent manganese content may be used. The plate steel body 5 of the flue F, in which the valve is embodied, is provided with circumferential flanges 6, and bolts or screws 7 secure the flanges 6 to the flanges 3 and thus integrate the valve body with the flue structure. The steel wall of the flue is provided with the usual lining 8 of refractory material, and the internal cylindrical surface of such lining is flush with the inner surface of the annular body of the valve.

The butterfly valve per se of the structure is of bipartite construction, comprising a pair of wings or gates 9 and 10 which may be formed of

plate steel cut to pattern and shaped as required, but they are preferably cast of the same metal as the valve body itself, and of the specific form hereinafter described. The two valve members are complementary in shape, each being formed as a substantially semi-circular plate, and such valve members are mounted to extend, when in closed position with the complementary diametrical edges of their semi-circular bodies positioned adjacent to each other, in a common plane across the interior of the cylindrical valve body. The disks are shown in such position in elevation in Figure 3 and in vertical section in Figure 2. In this position of the valve members, the passage through the flue is closed, not necessarily hermetically closed as herein illustrated, and the flow of the flue-dust laden gases through the duct is blocked. The two valve members or wings are rotatable in their mountings from said closed position into the open or partially open position shown in dotted lines in Figure 2, and it is important to note that in such open position the valve members 9 and 10 diverge in the upstream direction to thereby form a somewhat funnel-like opening that is aligned with the longitudinal axis of the flue F and is effective across the entire width of the throat of the valve body. By virtue of such feature of construction the flow through the flue with the valve in fully (or partially) open position is concentrated along the longitudinal axis of the flue. The marginal flow of gas which occurs over the outer peripheral edges of the valve disks flows into a space that diverges in a downstream direction and thus avoids direct impingement against the refractory lining. The gates or wings may be moved to an even more widely open position in which they offer minimum resistance to flow, or they may be opened to a lesser extent than that shown to restrict the flow of fluid therethrough.

It is also important to note that the funnel-like opening formed by the valve disks is promotive of stream-line flow, thus inhibiting eddying and turbulence in the stream of gases. In order to enhance this desirable stream-line flow, the inner body portions of the two valve disks are curved as indicated at 9a and 10a, respectively, the direction of curvature being such as to provide a rounded neck in the "funnel" of the open valve.

It is to be noted that the axes, on which the valve members are rotatable between open and closed positions, are located at an interval from the diametrical or inner edges of said members or gates, and that such interval is smaller or less than the interval between the axes and the opposite outer edges of the gates as may be seen in Fig. 2. The axes or stems of the valve disks may comprise shafts 11 and 12 that extend across the throat of the valve-body in spaced-apart and parallel relation, as shown in Figure 3. These stems are borne at their opposite ends in anti-friction bearings 13 supported in housing portions 14 formed integrally with the valve body 2.

Particularly effective means are provided for securing the valve gates to their rotatable stems or shafts, such means permitting the ready mounting and attachment of the gates upon the stems, and affording facility of removal of the gates therefrom. These means comprise a pair of flanges 15 formed integrally with the body of each valve gate and they are reinforced by integral webs 16, the flanges and webs serving also to reinforce the gate. The paired flange members 15 form channels in which the valve stems

are received, and cooperating with the members 15 are keepers 17. Advantageously the channels formed by and between the flanges 15 are polygonal (preferably square) in cross section, and the portions of the valve stems embraced thereby are of corresponding cross sectional form. The keepers 17 comprise cotter-pin elements that are tapered from end to end, and the flanges 15 are provided with suitable orifices through which such cotter-pin keepers are driven. The tapered keepers engage the outer flat faces of the embraced valve stems with wedging effect, and provide perfect security of assembly. The split ends of the keepers may, after installation be spread, as indicated at 17a in Figure 3, to prevent them from becoming dislocated in service.

While it is possible that the valve gates may be individually rotated between open and closed positions, it is desirable that they be rotated in unison. Means to this end comprise arms 18 and 19 respectively secured to the ends of the stems 11 and 12 projecting from the bearing housings 14 on one side of the valve body. The distal ends of the two arms are pivotally interconnected by a link 20, so that the two stems shall rotate in unison and in opposite directions of rotation, to move the valve gates between open and closed positions. The link 20 is extended in a portion 20a and to this portion the usual butterfly-valve-operating mechanism may be connected in a manner well understood in the art.

The inner edges of the gates are preferably provided with a rounded lip or head that resists corrosive action and retards splitting or warping of the disk, while the reinforcing structure formed by the webs and channels on the downstream faces of the gates prevents warpage and provides added heat dissipating surface.

The butterfly valve of the invention, while particularly designed for the service indicated, will find utility in many other fields. Needless to say, various modifications and changes in the structure of the valve described may be made without departing from the spirit of the invention defined in the appended claims.

We claim as our invention:

1. A valve structure including a body forming a valve throat, two butterfly gates mounted in said throat to extend in substantially a common plane across said throat, said gates being movable from such plane into a funnel-like position to permit flow centrally through said throat.

2. The structure of the next preceding claim, the bodies of said gates being curved towards the edges that are adjacent when the gates extend in said common plane, whereby turbulence of flow through the valve in open position is minimized.

3. A valve structure including a body forming a valve throat, two valve stems mounted in said body and extending in spaced-apart parallel relation across said throat, two butterfly gates each having open channel portions adapted to embrace one of said stems, keepers cooperating with the flanges of said channel portions to secure said gates one to each of said stems, said gates being complementary in shape and adapted in flow-throttling position to extend in substantially a common plane across said throat, and means for turning said stems to swing said gates from said plane to open a passage for flow between them.

4. A valve structure including a disk arranged in the throat of the valve, a stem extending transversely of the valve throat, said disk having flanges forming an open channel to receive said

stem, and means anchored to said flanges for securing the disk in locked position on the stem.

5. A valve structure including a disk arranged in the throat of the valve, a stem extending transversely of the valve throat, said disk having flanges forming an open channel to receive said stem, said stem having a flat surface, and means carried by said flanges and locked against said flat surface to secure the disk to the stem.

6. A valve structure including a disk arranged in the throat of the valve, a stem of polygonal cross section extending transversely of the valve throat, said disk having members forming an open channel embracing said stem, and wedge elements locked in said members and wedged against a face of said stem to secure the disk to the stem.

7. A valve for controlling the flow of high temperature gases comprising a body in the form of an annulus, a pair of shafts equidistantly spaced from a given diameter of said annulus and having their ends passing through the annulus, and a substantially semi-circular butterfly gate on each shaft and of a shape and area to substantially cover one-half the interior of the passage through the annulus.

8. A valve for controlling the flow of high temperature gases comprising a body in the form of an annulus, a pair of shafts equidistantly spaced from a given diameter of said annulus and having their ends passing through the annulus, and a substantially semi-circular butterfly gate on each shaft and of a shape and area to substantially cover one-half the interior of the passage through the annulus, said gates having plane faces in an upstream direction with the edge portions thereof which are along the meeting line of the two gates curved in a downstream direction from said plane, and a reinforcing structure on the downstream side of said gates.

9. A valve structure for controlling the flow of a fluid comprising a body having a passage therethrough, and two gates each mounted to turn in said passage on an axis extending transversely

and medially of the gate to swing between a position in which the two gates close the passage and a position in which the gates form a funnel-like passageway at the center of the passage.

10. A valve structure for controlling the flow of a fluid comprising a body having a passage therethrough, and two butterfly gates complementary in form and mounted in said passage with their axes in spaced relation to swing between a position in which the gates close the passage and a position in which the gates form in the passage a funnel-like passageway extending between said axes.

11. A valve structure for controlling the flow of a fluid comprising a body having a passage of circular cross section therethrough, and two semi-circular butterfly gates mounted in said passage with their axes in spaced parallel relation and positioned to swing on said axes between a position in which the gates close the passage and a position in which the gates form in the passage a funnel-like passageway extending between said axes.

12. The structure of the next-preceding claim, the axis of each butterfly gate being spaced at a smaller interval from the inner than from the outer edge of the gate, and means for swinging the gates to present the larger end of said funnel-like passageway in upstream direction in the valve passage.

13. A valve structure for controlling the flow of a fluid comprising a valve body having a passage therethrough, and two butterfly gates mounted in said passage with their axes in spaced parallel relation to swing between a position in which the gates close the passage and a position in which the gates form in the passage a funnel-like passageway extending between said axes, the body portions of said gates that extend between said axes when the passage is closed being complementarily curved, substantially as described.

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