Sept. 3, 1968 H. R. BILLETER ET AL 3,399,860

FLUSH VALVE INCLUDING ADJUSTABLE RESTRICTION

Filed Jan. 23, 1967 2 Sheets-Sheet 1

Fig. 1

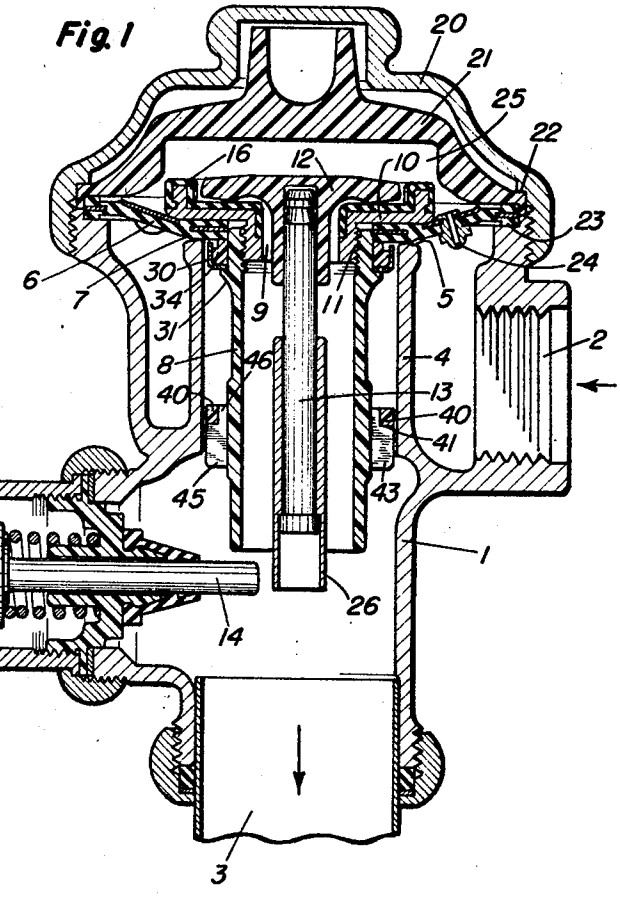


Fig. 5

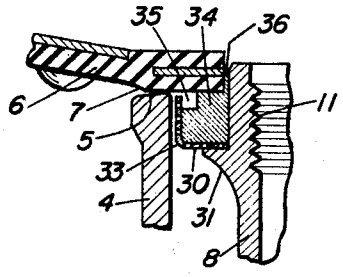


Fig. 4

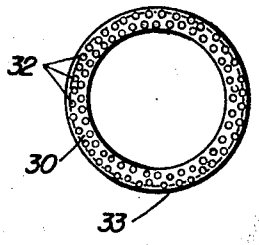


Fig. 2

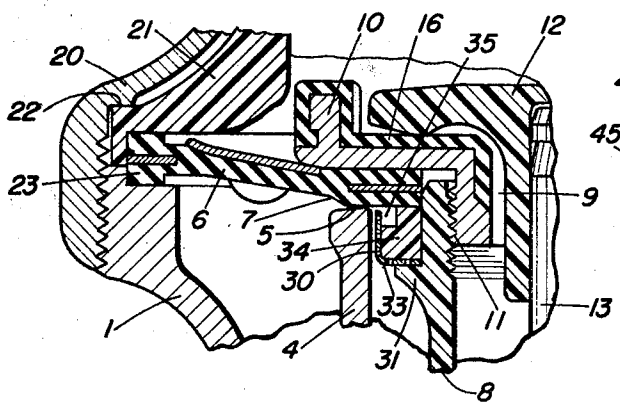
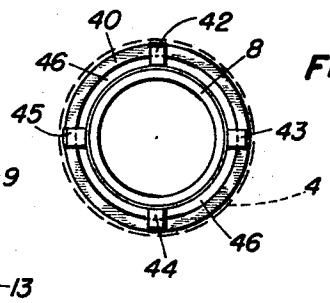


Fig. 3



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FLUSH VALVE INCLUDING ADJUSTABLE RESTRICTION

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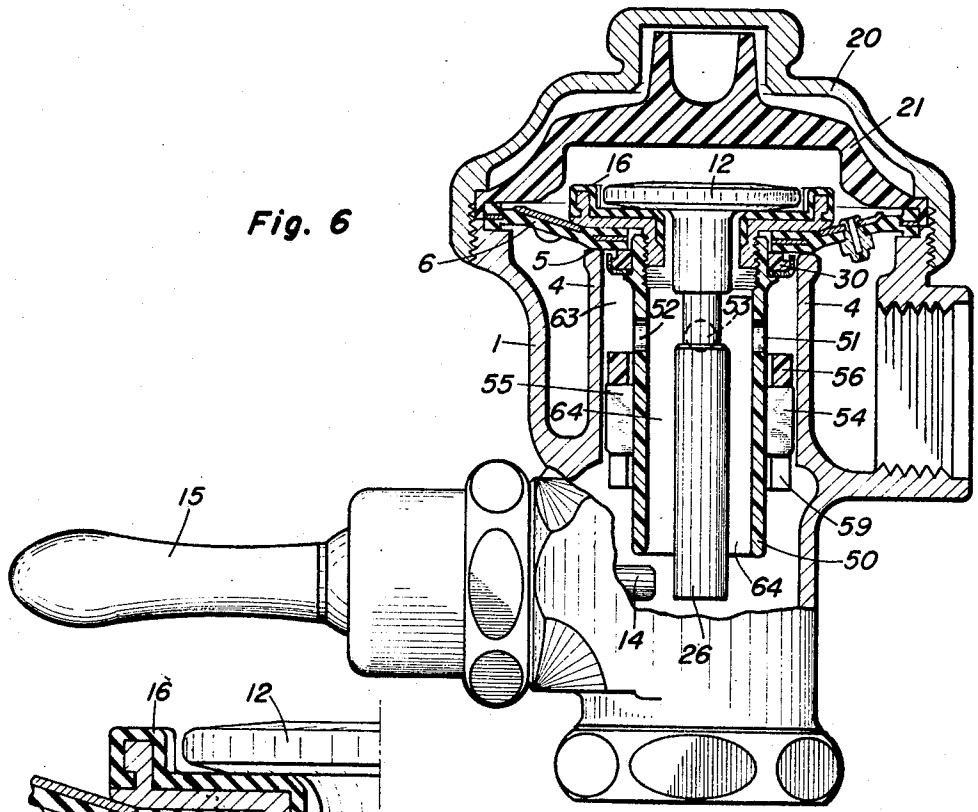
Fig. 6



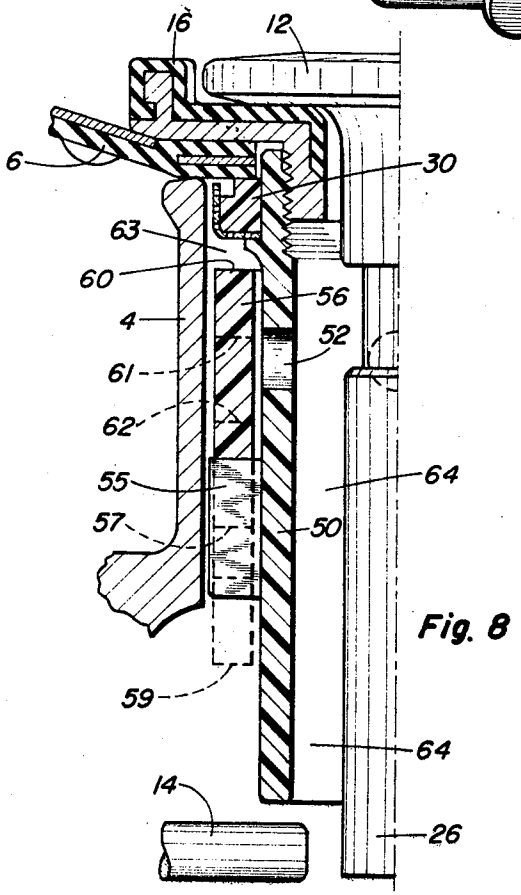


Fig. 8

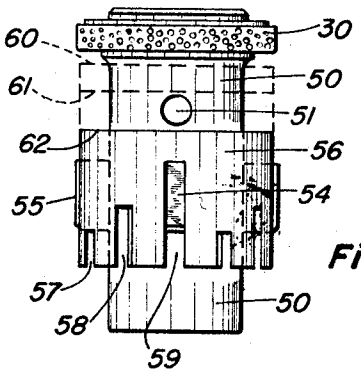


Fig. 7

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FLUSH VALVE INCLUDING ADJUSTABLE RESTRICTION

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11 Claims. (Cl. 251—37)

ABSTRACT OF THE DISCLOSURE

A diaphragm type flush valve having a depending guide in the valve barrel which is equipped with adjustable restriction means to quiet and regulate the amount of water flow, the guide having a quiet acting refill head located adjacent the valve seat.

Background of the invention

When flush valves are installed in plumbing systems where water pressures are relatively high, the valve closing action creates annoying noises during the so-called refill action by the valve guide. Attempts to employ rough surfaces or screens were not always satisfactory as these tended to clog. Prior valve guides also were not equipped with reliable means to adjust for the proper amount of water passed through the valve. This adjustment also has an effect in producing quiet action in the valve. The present flush valve is provided with an improved guide element having both novel refill quieting means and water flow adjustment means integrally incorporated therewith.

Summary

In diaphragm type flush valves, the diaphragm is usually provided with a depending guide within the barrel of the valve, which guide serves the purpose of properly guiding the diaphragm to and from its seated position and also tapers off the flushing action prior to complete valve closure. This action provides the refill portion of water for the water closet seal. In the present invention, this guide is provided with a novel refill head consisting of a perforated ring and associated concentric supporting ring to provide quiet closing action. In addition the guide has a novel restriction ring on it encircling the guide wings for regulating the amount of water flow through the valve. This restriction ring also has an inherent quieting effect on the water flow. The parts of the guide are easy to assemble, economical to produce, and function in a reliable manner. The guide and its parts are preferably made of suitable plastic materials for corrosion resistance and lightweight.

Description of the drawings

FIGURE 1 is a cross-sectional view of a flush valve showing the invention;

FIGURE 2 is an enlarged section of a portion of the flush valve showing the improved quieting feature;

FIGURE 3 is a bottom view of the guide;

FIGURE 4 is a plan view of the quieting disc;

FIGURE 5 is a fragmentary portion of the quieting feature in a modified form;

FIGURE 6 is a cross-sectional view of a valve with a modified form of guide having adjustable flow restriction means;

FIGURE 7 is a full side view of the modified adjustable guide; while

FIGURE 8 is a partial cross-sectional view on an enlarged scale of the adjustable guide.

Description of the preferred embodiment

Referring specifically to FIGURE 1, there is illustrated in cross-section a flush valve of well known construction such as the Sloan "ROYAL" Flush Valve, the general details of which need not be pointed out, except as they are concerned with the present invention. This flush valve includes the brass valve body **1** provided with an inlet water supply connection **2** and an outlet **3**, between which there is an interior upstanding barrel **4**. The upper edge of barrel **4** forms the annular main valve seat **5**. The main valve member consists of a flexible circular rubber diaphragm **6** having a bottom valve seating portion **7** and which is clamped to the top end of a cylindrical guide member **8** extending downward within the barrel **4**. The diaphragm **6** is provided with a central opening **9** through which a clamping disc **10** extends with a portion **11** threaded into the guide member **8**, to clamp the diaphragm **6** tightly between them. Certain other details of the diaphragm **6** are preferably constructed in accordance with Patent 1,714,573, issued May 28, 1929. A relief valve **12** is carried by the clamping disc **10** and has a depending operating stem **13** which extends through the diaphragm opening **9** and within the guide member **8**, the lower end **26** of the stem **13** being arranged opposite the actuating plunger **14**. Plunger **14** is adapted to be pushed inward by the handle operator **15** to tilt the relief valve **12** off its seat **16** across the opening **9** to initiate the operation of the valve.

The valve body **1** is provided with an external cover **20** and an internal cover **21**, the external cover **20** being screw threaded in to the body **1** and provided with a shoulder **22** which engages the outer peripheral edge of the internal cover **21** and presses it downwardly against the outer thickened edge **23** of the diaphragm **6** to clamp it firmly around its periphery in position in the valve body.

In the ordinary operation of the flush valve described, pressures are equalized above and below the diaphragm **6** through the small bypass opening **24**, and since the pressure area above the diaphragm in chamber **25** is greater than that below the diaphragm, the diaphragm is held tightly against valve seat **5**, shutting off the water flow between the inlet **2** and outlet **3**. Now when the plunger pin **14** is actuated inward by the operating handle **15** and contacts the stem **26**, the relief valve **12** is tilted from its seat **16**, so the pressure above the diaphragm in chamber **25** is relieved downward through the diaphragm central opening **9** to the outlet **3**, so that the water pressure from inlet **2** is effective to flex the diaphragm **6** upwardly from its seat **5** and permit water flow through the flush valve from the inlet **2** to the outlet **3**.

The telescoping element **26** depending from the stem **13** enables the relief valve **12** to close upon its seat in the event the handle **15** is held unduly long in the operated position. With the relief valve **12** again seated, the upper chamber **25** is gradually filled to inlet pressure through the bypass **24** thereby timing the length of the flushing action and the amount of water passing through the valve, until the diaphragm **6** is again seated on main seat **5**, shutting off the flow.

To reduce noise conditions when relatively high water pressures are encountered, the valve seat **5** is constructed so that it tapers or slants downward and outward from its inner edge to its outer edge as more clearly seen in FIGURE 2. The inner portion of the diaphragm seating section **7** first makes contact with the inner top edge of the seat **5** and then as the valve closing action continues, gradually closes onto the seat **5** progressively outward towards the outer edge until the diaphragm section **7** is fully seated. This action helps to prevent closing noise by pinching off the water flow gradually instead of with an abrupt "thump." This arrangement is more fully pointed out in Patent 2,776,812, issued Jan. 8, 1957.

It is known that the closing off noise of a flush valve which takes place immediately prior to the actual closing of the diaphragm upon its seat, as pointed out above, is greatly reduced or eliminated by the use of screens, rough surfaces and other means to break up the jet-like streams to reduce the velocity and cushion the flow of water, quieting the flush valve. In the present arrangement this is combined with the so-called refill head and comprises an annular perforated disc **30** which rests upon and around a shoulder **31** formed at the upper end of the guide **8**. The disc **30** is L-shaped in cross section and is provided with a multiplicity of small holes **32** of .027 inch size. The junction **33** of the two surfaces of the disc **30** is rounded off as shown. An annular refill head **34** conforms to and rests within the angle of the perforated disc **30** and has an annular stepped portion **35** formed in it immediately below the bottom of the diaphragm seating portion **7**. The diaphragm **6** clamps directly on top of refill disc **34** and with perforated disc **30** is held against shoulder **31** by the threaded molded disc **16** so that the discs **30**, **34** and guide **8** move up and down in unison with the movement of the diaphragm **6**.

In the closing action of the diaphragm, the refill head assembly comprising the perforated disc **30** and disc **34** gradually move down into the barrel **4** and constricts the flow just prior to complete valve closure. This enables a small quantity of water to flow into the closet bowl which is syphoned out by the closet bowl action and which serves as a water seal in the bottom of the closet bowl. As pointed out previously, the closing movement of the diaphragm just prior to its seating results in greater velocity flow of the water and at higher water pressures this usually causes annoying audible noises. The high velocity streams impinging upon the rough surface of the perforated holes of the disc **30** are broken up and create turbulence in that area, slowing down the velocity of the stream and thereby eliminating the noise. The noise reduction is also assisted by the ledge **35** in disc **34** which acts as a pocket to trap a portion of the flow and cause it to create a reverse action with increased turbulence. The combination of the perforated disc **30** and disc **34** in the exact relationship is important for optimum quieting results. The curved portion **33** of the perforated disc **30** and the part of disc **34** which rests within it is critical for this purpose as numerous tests have proved. The arrangement of the refill head assembly while achieving quietness in valve operation also precludes the possibility of clogging the perforations **32** since the water flow does not take place through the holes but only over the rough surfaces created by the holes as more clearly seen in FIGURE 2.

In the modification FIGURE 5 the disc **34** is shown with a thin upstanding flange **36** which serves as a centering spacer and support for the diaphragm **6** when clamped with the discs **30** and **34** to the shoulder **30** of guide **8**. In both forms of the refill head, the two parts **30** and **34** are economical to produce, easy to assemble and function in a reliable manner to reduce noise.

In order to further assist in quieting the water flow through the valve and for other purposes, the cylindrical guide **8** is provided near its lower end with a restriction ring **40** which encircles the guide **8** and is supported thereon in close proximity to the inner wall of the barrel **4**. The restriction ring **40** rests upon a recess or notch **41** formed in each of the four separate guide wings **42**, **43**, **44** and **45** extending integral with and outward around the guide **8** into close proximity of the barrel **4**. The restriction ring **40** in its supported position is also spaced from the outer wall of guide **8** and thereby provides an annular passage **46** for the flow of water downward between the guide member **8** and the barrel **4** as seen in FIGURE 3. The guide wings **42** to **45** serve to properly guide the guide member **8** near its lower end as it reciprocates within the barrel **4** in the opening and closing valve movements of the diaphragm **6**.

The presence of the restriction ring **40** provides a certain amount of back pressure to the flow of water through the valve, which back pressure tends to reduce the velocity of water flow and thereby contributes to the quieting action of the valve.

In the accepted practice in the plumbing trade, the flush valve is required to deliver at least 4½ to 5 gallons of water at 30 g.p.m. to properly flush a water closet. The presence of the restriction ring **40** of the size and width indicated, and which bridges approximately half the space between the guide member **8** and the barrel **4**, will deliver the above quantity of water through the passage **46** before the valve shuts off. When the restriction ring **40** is entirely removed, the passage **46** is much greater so that a quantity of at least 6 to 7 gallons are delivered at 30 g.p.m,. for flushing a slop sink for example. When the flush valve is to flush a urinal fixture which requires only about 1-gallon flush, the restriction ring **40** is removed and another ring substituted therefor which is half again as wide as ring **40**, so the passage **46** is greatly restricted. The rate of flow in this case, however, is reduced to about 6 g.p.m. by the throttle stop (not shown) usually on the inlet side **2** of the valve.

It will be understood, of course, that the water flowing through the valve and impinging upon the restriction ring **40** will result in the diaphragm **6** being more forceably pulled down upon its seat **5**, assisting the metering action caused by the water passing through bypass **24** into the chamber **25**. Less water will therefore pass through the valve as a thicker restriction ring **40** is employed and the valve will therefore close sooner.

The removal or replacemnet of different restriction rings **40** is easily accomplished by simply taking off the valve covers **20** and **21**, lifting out the diaphragm **5** and then unscrewing the molded disc **16** from the guide member **8**. The quieting discs **30** and **34** are then removed after which the restriction ring **40** may be slipped down upon the recess **41** of the wings **42–45** on the guide **8** or replaced therefrom as desired.

For the purposes of lightweight, economy in manufacture and corrosion resistance, certain parts of the flush valve are preferably made of molded plastic materials. These materials also exhibit other strong characteristics such as dimensional stability, unaffected by different kinds of water, good strength, smooth action and reliable operation. The inside cover **21**, the top of relief valve **12**, the guide member **8** and the restriction ring **40**, all may be made of DuPont "Delrin" materials to serve the purposes defined. Another desirable plastic material favored is "Cycolac X–27," a product of Borg-Warner Co. The diaphragm **6**, of course, is of molded rubber while the remaining elements concerned with the invention are made of brass as usual.

Description of the modification of the invention

Referring now specifically to FIGURES 6 and 7, the construction of the flush valve generally is the same as in FIGURE 1 except for the guide and the flow restriction device. In this arrangement the flow device is adapted to be variably adjusted to permit a quantity of up to four different amounts of water to pass through the flush valve. The guide **50** is cylindrical shaped and similar to that of

FIGURE 1 and is supported at its top end to the diaphragm **6** in the same manner. The quiet acting refill head **30** is likewise clamped to the guide **50**. Adjacent the top end of the guide there is a series of openings or water passages **51**, **52** and **53** bored in the sides of the guide, and four spaced apart guide wings such as **54** and **55** are formed integral with the guide and extend outward in close slidable proximity of the inner walls of the barrel **4**.

A flow restriction cylinder shaped device **56** loosely encircles the outer circumference of the guide **50** and is about half the length of the same. Cylinder **56** has a series of slots such as **57**, **58**, and **59** cut into it from the bottom side upward. Each slot is of a different length and there are four sets of similar slots for the four guide wings such as **54**, equally spaced around the guide **50**. Each of the steps or slots represents a different flow restriction to the passage of water through the valve. This flow restriction cylinder **56** is easily removed for different adjustments by simply unscrewing the molded relief valve seating disc **16** from the top of the guide **50**, taking off the diaphragm **6** and quiet disc **30**, and then either removing the cylinder **56** or rotating it and dropping it down so that the four wings such as **54–55** slip into the desired one of the slots **57**, **58**, or **59** where the cylinder **56** remains held down in place by frictional force and gravity during water flow through the flush valve.

Referring now to FIGURE 8 which shows an enlarged fragmentary portion of the adjustable flow arrangement, when the flow device **56** is adjusted with the short slots **57** slipped over the wings **55**, the upper edge **60** of the flow device will be closely adjacent the quiet disc **30**, thereby partially blocking or restricting the water flow passing downthrough the passage **63**. A portion of the flow also passes through the ports **51**, **52**, and **53**. In this position of the flow device, the volume of water passed through the flush valve is approximately one (1) gallon, suitable for flushing a wash down urinal for example. Should the flow device **56** be adjusted so the intermediate slots **58** are slid over the wings **54–55**, the top edge of the device will be located as indicated at **61** opposite the top of the ports **51–53** partially blocking the same. This position of the device permits a volume of about three (3) gallons of water to pass before the flush valve shuts off, and this is a suitable amount for a pedestal type urinal for example.

When the flow disc **56** is adjusted with the long slots **59** in engagement with the guide wings **54** in the positions depicted in FIGURES 6 and 7, the top edge **62** of the device will be opposite the bottom of the openings **51–53** in the guide **50**. In this position, water flow takes place through the water ports **51–53** and down through the interior **64** of the guide **50** as well as though the passage **63** on the outside of the guide. The amount of water passed before full valve closure will be about 4½ gallons, the usual volume required to adequately flush a water closet.

The foregoing amounts of water passed through the flush valve and the various positions in which the flow device **56** is adjusted, assumes that the water pressures at the inlet of the flush valve are of normal values, say about 30 to 50 p.s.i. In the event that the water pressures are abnormally low so that the last adjustment described above does not produce an amount of water (4½ gals.) for satisfactorily flushing a water closet, the flow device **56** is entirely removed from the assembly on the guide **50**, thereby permitting a ful flow of water through the flush valve through both passages **63** and **64** without restriction, to hasten the valve closing action.

The throttle or shut off valve (not shown) which is always associated with the inlet **2** of the flush valve to control the flow rate, is adjusted wide open on low pressures and throttled down on excessively high pressures to suit the fixture to which the flush valve is attached. Often the flush valve is installed on a so-called slop sink which requires an amount of flush up to 7 gallons. This can only be provided when the throttle valve is wide open and relatively high pressures are present. The flow device **56** is therefore entirely removed so that no restriction is present to the free flow of water.

The following chart indicates the various adjustments possible with the flow device, as pointed out above specifically.

Position of flow restriction device on valve guide	Amount of water (gal.)	Type of plumbing fixture
At top end	1	Wash out urinal.
Intermediate	3	Pedestal urinal.
At bottom end	4½	Water closet.
Removed (for low pressures)	4½	Do.
Removed (for high pressures)	7	Slop sink.

We claim:

1. In a flush valve having inlet and outlet water passages:

an upstanding barrel portion in said flush valve having a main valve seat around the top end thereof,

a flexible diaphragm having a central opening therein surrounded by a main valve seating portion,

a cylindrical hollow guide member depending from said diaphragm and extending through said barrel portion,

a relief valve seatable across the diaphragm opening and having an operating stem depending through said guide member,

guide wings extending from around the lower end of said guide member into spaced relationship with said barrel portion,

means for operating said relief valve to cause said diaphragm to open from said main valve seat and permit water flow through said flush valve and through the passage between said barrel and said guide member, and

flow restriction means removably supported upon said guide wings,

said flow restriction means comprising a ring member encircling said guide member and spaced from said barrel and said guide member to provide a narrow passage to restrict the amount of water flow through said flush valve,

said flow restricting member also creating a certain amount of back pressure to the flow of water to assist in quieting the closing action of said main valve upon its seat.

2. In a flush valve having an operating diaphragm and a barrel portion forming a water passage together with a main valve seat at the upper end of the barrel upon which said diaphragm is seated,

a cylindrical hollow guide member supported from said diaphragm and extending into said barrel portion,

a plurality of guide wings extending outward from the lower end of said guide member into slidable contact with said barrel portion,

the space between said guide member and said barrel portion constituting the main passage for water flow through said flush valve, and

a flow restriction ring removeably supported on a notched portion on the top of each of said guide wings,

said flow restriction ring being of a size to partially restrict the water flow through said passage and when removed provide full flow,

said flow restriction ring also generating back pressure to free flow of water to assist in quiet closing action of said diaphragm upon its seat.

3. In a flush valve having an operating diaphragm and a barrel portion providing a water passage together with a main valve seat on the top end of said barrel portion for the diaphragm to seat upon and control the water flow through the flush valve,

a hollow cylindrical guide member attached to said diaphragm depending therefrom into said water passage and into said barrel,

a quiet acting refill head on the top end of said guide member adjacent said main valve seat,

said refill head comprising a perforated disc L-shaped in cross section and a solid disc nesting within said perforated disc having a stepped portion around its circumference adjacent its outer edge,

said refill head being clamped and supported between the top of said guide member and said diaphragm,

said quiet refill head being located adjacent said main valve seat in the closed position of said valve,

said refill head effective to quiet the flow of water into said passage immediately prior to complete valve closure and to simultaneously restrict flow through said passage, and

means on the lower end of said guide for further controlling the flow of water through said passage and for assisting in quieting the closing action of said valve.

4. In a flush valve having an operating diaphragm and a barrel portion with a valve seating portion at its upper end for the diaphragm to seat upon,

a hollow cylindrical guide member depending axially from said diaphragm into spaced relationship with said barrel portion,

guide wings on said guide member bridging the space between said guide member and said barrel portion,

said guide wings being located at the lower end of said guide member and each having a notched portion at its outer end adjacent said barrel,

a flow restriction ring supported on the notched portion of said guide rings and encircling said guide member,

said flow restriction ring being spaced from said guide member and of a width to provide a restricted amount of water to pass between said guide member and said barrel when the diaphragm is unseated,

said flow restriction ring being removable from said supporting guide wings to provide a full amount of water to pass through said flush valve.

5. In a flush valve having a diaphragm and a barrel portion, the upper end of which provides a seat for the diaphragm.

a hollow cylindrical guide member supported by and axially depending from said diaphram into said barrel portion,

said guide member being spaced from the walls of said barrel portion and provided with a series of guide wings bridging said space, and in slidable relationship with said barrel portion,

a flow restriction ring removably insertable over said guide member and encircling the space between said guide member and said barrel portion,

said flow restriction ring having a series of slots formed reentrant from the bottom end whereby said flow restriction ring is supported upon said guide wings in a position to provide a restricted amount of water flow, and

means for supporting said flow restriction ring in different positions on said guide wings to provide a variable amount of water flow through the flush valve.

6. In a flush valve having a diaphragm and a barrel portion, the upper end of which provides a main valve seat for the diaphragm,

a hollow cylindrical guide member supported by and axially depending from said diaphragm into said barrel portion,

said guide member being spaced from the inner walls of said barrel portion and having a series of guide wings thereon bridging said space,

a cylindrical flow restriction ring removably insertable on said guide member and partially occupying the space between said guide member and said barrel portion,

said flow restriction ring having a series of reentrant slots in it extending upward from the bottom end thereof,

each of said slots being of a different length, said slots fitting over said guide wings to support said flow restriction ring in different positions upon said guide member depending upon which length of slot is fitted over the guide wings,

the position of said flow restriction ring on said guide member determining the amount of water flow passed through said flush valve.

7. In a flush valve having a diaphragm and a barrel portion, the upper end of said barrel portion providing a valve seat for said diaphragm,

a cylindrical guide member supported from and axially depending from said diaphragm into said barrel portion,

said guide member being spaced from the inner walls of said barrel portion to provide a flow passage therebetween,

said guide member having at least four guide wings thereon extending across said flow passage and in slidable relationship with said barrel portion,

a flow restriction ring encircling said guide member and partially occupying the flow passage,

said flow restriction ring having four sets of slots formed reentrant from the bottom end thereof,

the slots of each set being of a different length,

one slot of each set adapted to be slid over one of said guide wings to support the flow restriction ring thereon,

the different slots determining the position that said flow restriction ring occupies upon said guide member whereby the amount of water flow through said flow passage is variably adjusted,

the shortest slot providing the least restriction and therefore the least amount of water flow,

the intermediate slot the next greater amount, and the longest slot the greatest amount of water before the diaphragm closes upon the valve seat.

8. The flush valve as claimed in claim **7**, in which the flow restriction ring in its various adjusted positions on said guide member is moved into closer or further apart relationship with the main valve seat to variably restrict the flow.

9. The flush valve as claimed in claim **7**, in which complete removal of the flow restriction ring from the guide member provides a full unrestricted flow of water through the flow passage.

10. The flush valve as claimed in claim **7**, in which the guide member has a series of flow passages in the sides thereof which in certain positions of the flow restriction ring are partially blocked off to restrict the water flow therethrough to the amount determined by the adjusted position of the flow restriction ring.

11. The flush valve as claimed in claim **7**, in which the guide member is also provided with a refill head adjacent the valve seat which quiets the water flow and in which the flow restriction ring by restricting the flow assists the refill head in the quieting action.

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ARNOLD ROSENTHAL, *Primary Examiner.*