

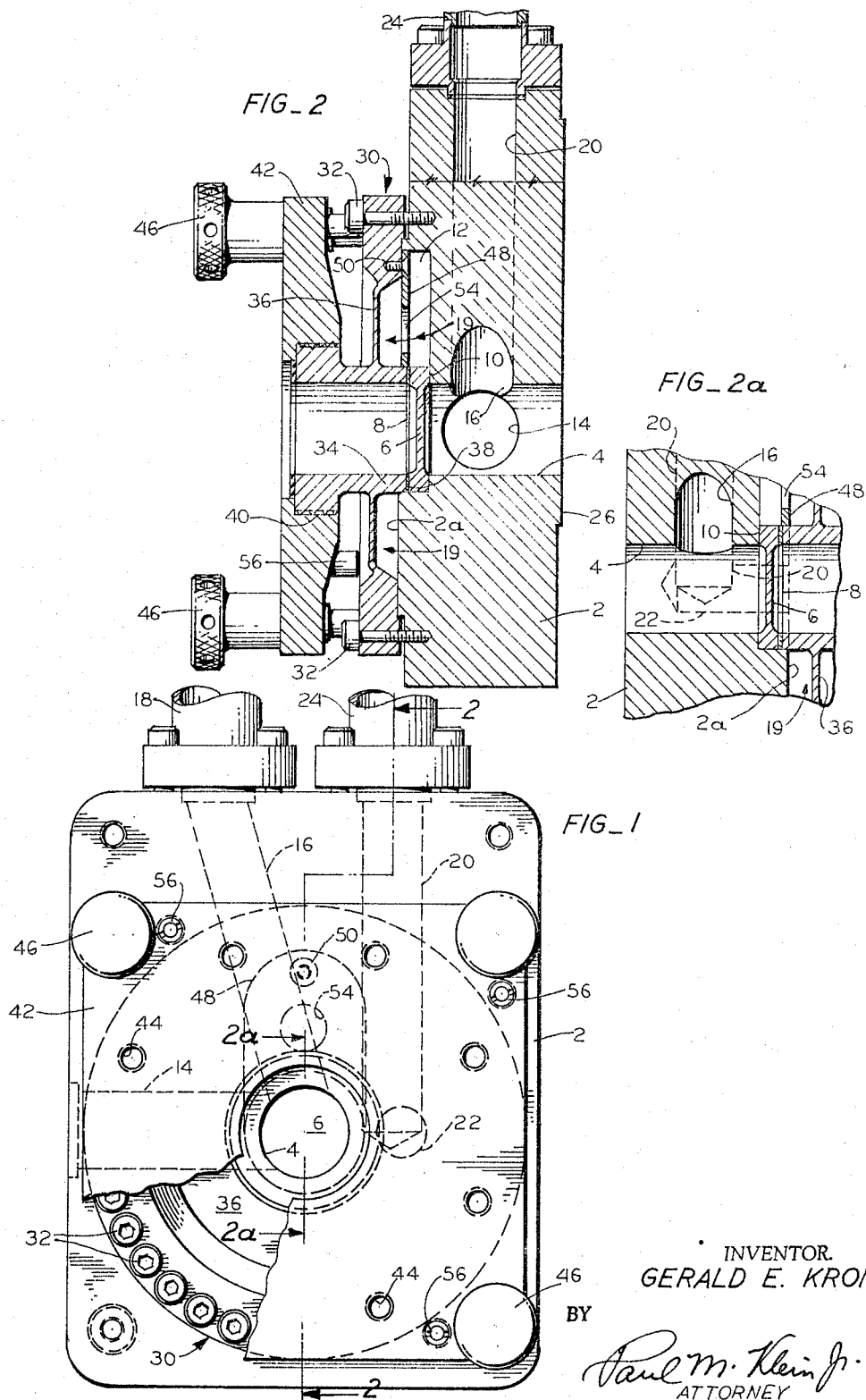
Aug. 16, 1966

G. E. KRON
BAKEABLE, LEAKPROOF, STRAIGHT-THROUGH
ULTRA-HIGH VACUUM VALVE

3,266,505

Filed Oct. 31, 1963

2 Sheets-Sheet 1



Aug. 16, 1966

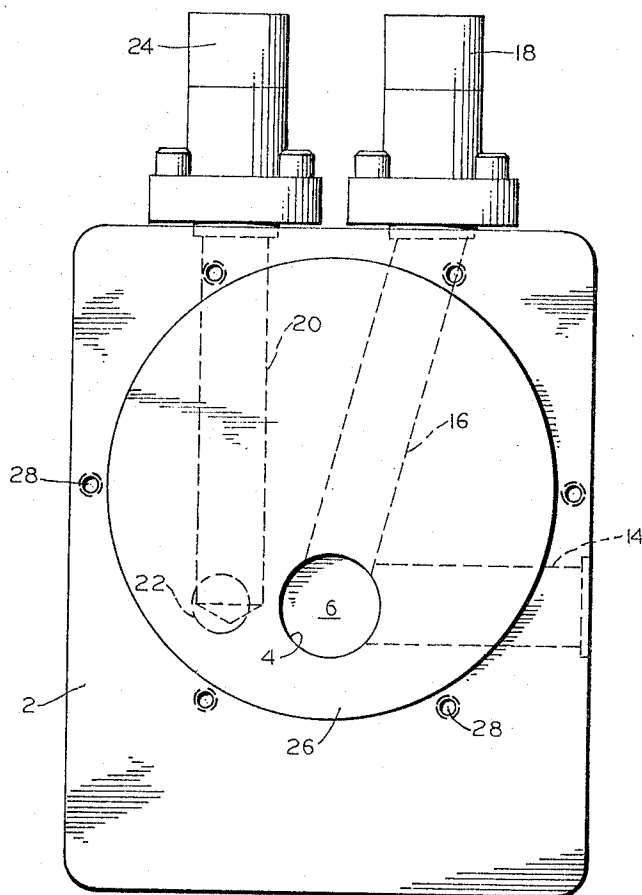
G. E. KRON
BAKEABLE, LEAKPROOF, STRAIGHT-THROUGH
ULTRA-HIGH VACUUM VALVE

3,266,505

Filed Oct. 31, 1963

2 Sheets-Sheet 2

FIG_3



INVENTOR.
GERALD E. KRON

BY

Paul M. Klein Jr.
ATTORNEY

1

3,266,505

BAKEABLE, LEAKPROOF, STRAIGHT-THROUGH ULTRA-HIGH VACUUM VALVE

Gerald E. Kron, Mount Hamilton, Calif., assignor, by
mesne assignments, to the United States of America as
represented by the Secretary of the Navy
Filed Oct. 31, 1963, Ser. No. 320,588
5 Claims. (Cl. 137—38)

This invention relates to a leakproof, straight-through valve and more particularly to such a valve adapted for use with ultra-high vacuum.

Prior art valves for use with high vacuum typically are sealed with grease, gaskets or the like and hence are not clean by the standards required for the preservation essentially free of contamination of certain areas or equipment in a region in communication with these valves. Additionally, certain prior art valves are so configured as to provide relatively long and non-rectilinear passageways therethrough.

An object of the present invention is to provide a valve having a short, completely unobstructed, straight-through passageway. Another object of the invention is to provide such a valve adapted for use with an ultra-high vacuum. Still another object of the invention is to provide such a valve which, being all metal, is bakeable.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is an elevation view, partly broken away, of the low pressure side of a valve constituting one preferred embodiment of the invention;

FIG. 2 is a cross-sectional view taken along the line 2—2 in FIG. 1;

FIG. 2a is a fragmentary cross-sectional view taken along the line 2a in FIG. 1; and

FIG. 3 is an elevation view of the embodiment of FIG. 1 taken from the high pressure side.

In certain environments it is desirable to have a valve which is leakproof when used with an ultra-high vacuum and which provides a relatively short, straight passageway through itself and which can be baked at a relatively high temperature without deterioration. One application for which such a valve is useful is in connection with an image tube or electronic camera which consists of a photoemissive semi-transparent cathode upon which a light image is focused. The electrons emitted from the opposite side of the cathode are focused by means of electron optics either directly upon an electron-sensitive recording material or upon a phosphor which subsequently is photographed to preserve a permanent record. In such a system it is desirable to have a short, straight, unobstructed path for the electrons emitted from the cathode to travel to the photographic film, for example. The photoemissive cathode must be maintained in a region of very high vacuum essentially uncontaminated in order to insure efficient use of it. Since it is desirable to expose a number of films to the photocathode and remove the films for development without disturbing the clean high vacuum surrounding the photocathode, it became apparent to applicant that a valve having the characteristics of the present invention would be desirable. The valve has general utility and can be used in various systems, but it is remarkably useful in an image tube system. The specifically illustrated embodiment will now be described in general, but with particular illustration of its use in an image tube system.

Reference is now made to the drawing, in certain figures of which there are omitted for clarity certain dotted lines indicating portions hidden from view. Numeral 2

2

indicates a valve body made of stainless steel or other similar suitable material. The body 2 has a bore 4 straight through it and adapted to be closed by gate 6 made generally in the form of a disc or coin. To insure a good seal the gate preferably has a relatively soft surface at least in the area which seats on the high pressure side against the valve body 2. This can be accomplished by making the entire gate of a suitable material such as pure gold, copper, or aluminum. Alternatively, the main body of the gate can be made of a base metal on which there is an overlay, as indicated in FIG. 2 at 8 and 10, of a soft metal such as tin, copper, aluminum or gold applied by plating, bonding or other suitable process. Gold of course allows for a higher baking temperature than tin, for example. With this latter alternative method of construction the base metal of the disc can be magnetic material such as nickel to facilitate displacing the gate by means of a magnet. An oblong counterbore 12 is formed in the valve body 2 to provide a chamber and guide to contain the gate 6 and permit the gate to roll and/or slide into closed position as viewed in FIG. 2 and also to the opposite end of the counterbore to fully open the passage through the bore 4.

For general preliminary evacuation of an evacuated system in which this valve can be used, there can be provided, in the body 2, a bore 14 communicating with the main bore 4 for attachment of a valve leading to a conventional vacuum pump. Also communicating with the main bore 4 is a port 16 leading to a tube 18 for connection to an ion pump to produce the final desired high vacuum after general evacuation. To draw off leakage from what may be termed the leakage chamber 19, comprised of the oblong chamber 12 and the region in free fluid flow communication with it when the valve is closed, a port 20 is provided. The port 20 communicates at its one end with this leakage chamber 19, through a connecting passage 22 drilled in from surface 2a of body 2 as seen in FIGS. 1 and 2a, and at its other end with a tube 24 leading to another ion pump.

To facilitate attachment to the valve body of equipment in a region of relatively high pressure, any convenient means can be employed such as the boss 26 with a finely finished surface appropriate to mate with a fixture held against it by screws entering the threaded holes 28 (FIG. 3).

To effectively close the valve by forcing the gate 6 into a tight seal against its mating surfaces, there is a closing diaphragm member generally indicated at 30 fastened by screws 32 into fluid-tight sealing relation against the body 2. The member 30 includes a central hub 34 supported by a diaphragm 36 and having a ground and polished surface 38 to bear against the gate 6. Fastened to the hub 34 or diaphragm member 30 by any convenient means, such as the threaded connection 40, is a coupling flange 42. The flange 42 serves two purposes. By virtue of fastening means such as threaded holes 4, it offers means for the attachment of equipment to the low pressure side of the valve. It also serves to transmit to the hub 34, from capstan screws 46 screwed into bushings threaded into body 2, the force necessary to bear against the gate 6 to hold it in closed sealing position or in open position. Each capstan screw 46 is retained in association with the flange 42 by a snap ring (not numbered but visible in FIG. 2) seating in a groove formed in the small diameter portion of the screw 46. A gate-retaining plate 48, for retaining the gate in open position, is held to the diaphragm member 30 by any convenient means such as screw 50. To insure adequate communication for free fluid flow between the portions of the leakage chamber 19, bounded in part by the diaphragm 36 and the base of oblong chamber 12, a hole 54 is made in the plate 48.

Stop screws 56, fastened into coupling flange 42 and adapted to stop against valve body 2, limit the motion of the diaphragm member 30 and guard against a ruinous crushing of the soft sealing surface of the gate 6.

Operation

As previously indicated the valve of the present invention is of general utility but will be described for illustration only as it can be used with an electronic camera or image tube. In such a case, all parts of the valve are made of metal to allow for baking the entire assembly to outgas the image tube containing the photoemissive cathode. The part of the tube containing the cathode typically has a metal base including a mounting flange adapted to be clamped in fluid-tight relation to the coupling flange 42. The part of the equipment adapted to contain photographic films or the like can be clamped in fluid-tight relation to the high pressure side of the valve against the boss 26 using screws to enter the holes 28 (FIG. 3). This part may include a plate or the like, capable of withstanding outgassing baking temperatures and adapted to seal against the surface of the boss 26 to close off the port 4 from access to the atmosphere. With this plate in sealing position and the tube containing the photocathode sealed against the flange 42, the capstan screws 46 are unscrewed to release the pressure of the hub 34 against the gate 6. This allows the snap rings of the capstan screws 46 to withdraw the hub 34 from engagement with the gate 6. The entire assembly can then be tilted so that the gate 6 rolls and/or slides under the action of gravity into the dead end of the oblong chamber 12 milled or otherwise formed in the valve body 2. If the gate 6 is comprised of magnetic material and the remaining principal parts of the assembly are of non-magnetic material, a magnet can be used to move the gate into the open position. Once the gate is in the open position it can be retained there by simply tightening again the capstan screws 46 so that the gate retaining plate 42 presses the gate against the bottom of the oblong counterbore 12. Since the invention requires no lubricant whatever and contemplates making all the valve parts of metal, if desired, the entire assembly including the tube containing the photocathode and the valve itself can be baked at relatively high temperatures to outgas the tube while the major vacuum is applied from a pump connected to the bore 14, and the final ultra-high vacuum is achieved by means of an ion pump connected to the tube 18.

When the desired vacuum has been reached, the tube containing the photocathode can readily be sealed off by simply loosening the screws 46 and rolling and/or sliding the gate 6, by means of a magnet or gravity, back into the position shown in FIG. 2 where it is in registration with the valve port, i.e. the opening of the bore 4. This closes the valve. To make the valve tight, the gate can be squeezed against the seats of its two sealing surfaces by means of the diaphragm member 30. Again the necessary force is applied by means of the jack screws 46 acting on the intermediate flange 42 to urge the hub 34 axially against the gate 6. As previously mentioned the stop screws 56 limit the motion of the diaphragm member to prevent crushing of the soft sealing surface of the gate 6.

When the gate is closed the little volume in the leakage chamber 19, comprised partly of the oblong chamber 12, is isolated. This volume is continuously pumped with a small ion pump connected to the tube 24. It is then possible to remove the seal from the boss 26 for the purpose of inserting or removing film and the like without losing the vacuum in the tube containing the photocathode. Any leakage at the valve seat engaging surface 10 on the side exposed to the atmospheric pressure is drawn off by this ion pump so that no leakage takes place across the seat engaging surface 8. Once the film is properly in place and the high pressure side of the valve at the boss 26 is sealed off from the atmosphere, the general evacu-

ation pump connected to the bore 14 is used to evacuate the region just previously open to atmospheric pressure and the ion pump connected to tube 18 is used to produce the final ultra-high vacuum matching that within the tube containing the photocathode. Thereafter the screws 46 are again turned to release the pressure on the gate 6 and the gate is moved into open position and there retained by plate 48. This leaves a short, straight passage through the bore 4 between the photocathode region and the film region. It should be noted that in the operation of this valve the sealing force is applied after and separately from the closure action. This is particularly desirable in an ultra-high vacuum environment for the reason that under such an environment metal-to-metal surfaces will gall and stick during opening and closing cycles if there is any appreciable pressure forcing them against one another.

Various modifications can be made within the scope of the invention. For example, if the valve does not require baking at relatively high temperatures, some or all of the parts may be made of materials other than metal. Although the gate is shown in the form of a round disc, other shapes can be used for the gate, as long as the gate is loosely fitting within the counterbore to enable it to move freely therein when it is free of external pressures.

Obviously many other modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A straight-through, leakproof valve comprising a valve body having a bore therethrough; and a counterbore on one face of said body encompassing said bore;
- a gate, generally in the form of a disc, located in said counterbore and loosely fitting therein, large enough to span said bore when in closed position to close said bore by sealing against the base of said counterbore around said bore, and when free of external axial pressure, freely movable within said counterbore between closed position and open position, in which latter position it leaves completely unobstructed passage through said valve straight through said bore;
- a diaphragm member fixed in fluid-tight sealing relation to said face of said valve body to form a leakage chamber including said counterbore;
- said diaphragm member including a diaphragm, a hub carried by said diaphragm and mounted for to and fro motion generally axially of said bore both to bear sealingly against said gate to exert pressure thereon to seal said gate against the base of said counterbore over said bore to close said valve and also to release pressure from said gate, said hub defining a flow passage through said diaphragm member communicating with said bore when said gate is in the valve open position, and means for applying pressure to said gate when said gate is in open position to force said gate against said valve body to retain said gate in open position;
- means for applying force to said hub to urge it axially of said bore;
- means for evacuating said bore; and
- means for evacuating said leakage chamber.
2. The valve of claim 1 further including means to limit the motion of said hub toward said gate whereby to limit the force exerted by said hub on said gate.
3. The valve of claim 1 wherein all parts are of metal whereby said valve can be baked without impairing its operation.
4. The valve of claim 3 wherein at least the area of

3,266,505

5

said gate which seats against said valve body to close said valve is of a metal selected from the group consisting of gold, copper, aluminum, and tin.

5. The valve of claim 1 wherein said gate is comprised of magnetic material and the principal remaining parts of said valve are made of essentially non-magnetic material.

References Cited by the Examiner

UNITED STATES PATENTS

1,938,460 12/1933 Muff ----- 251—159 X

2,666,539
3,170,668

1/1954
2/1965

6
Avery -----
Aulisa -----

250—41.9 X
251—193 X

FOREIGN PATENTS

5 825,944 12/1959 Great Britain.
881,388 11/1961 Great Britain.

WILLIAM F. O'DEA, *Primary Examiner.*

10 R. GERARD, *Examiner.*