July 20, 1954 E. W. RICKMEYER 2,684,052

WRITING INSTRUMENT

Filed Sept. 11, 1948

Fig. 1.

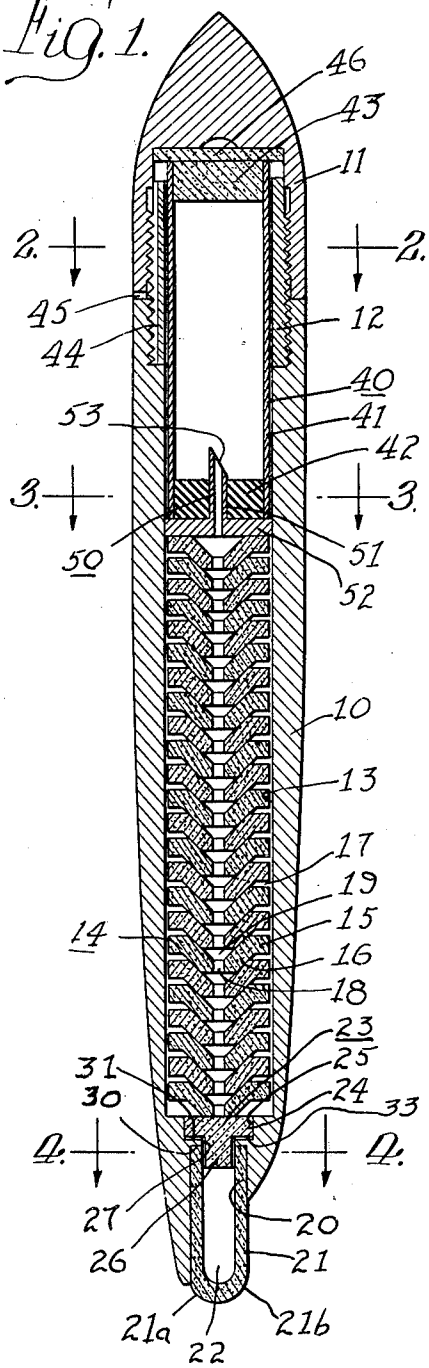


Fig. 2.

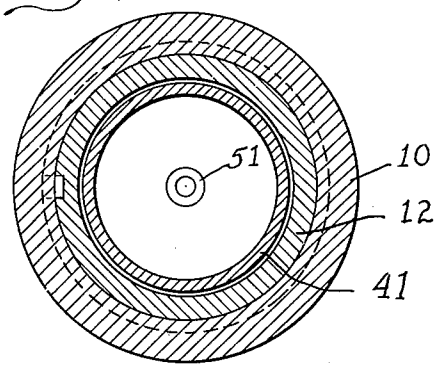


Fig. 3.

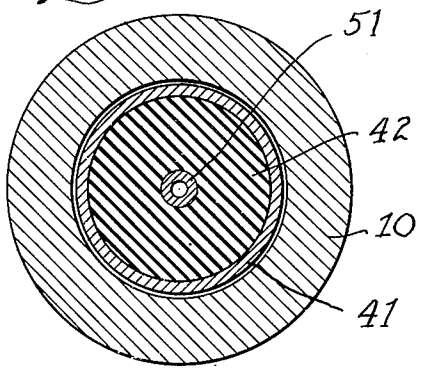
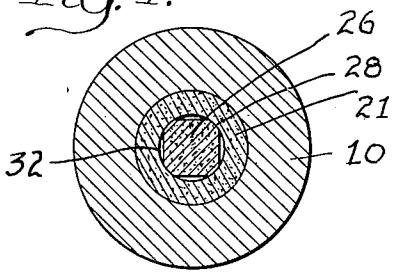


Fig. 4.



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WRITING INSTRUMENT

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Application September 11, 1948, Serial No. 48,836

14 Claims. (Cl. 120—42.16)

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This invention relates to ink-writing instruments and has to do more particularly with an instrument of the type having a capillary ink storage reservoir.

An object of this invention is to provide an improved writing instrument of the foregoing type.

Another object is to provide an improved capillary filler and reservoir element for a writing instrument.

Another object is to provide a capillary filler and reservoir element which is simple and inexpensive to manufacture and assemble, rugged in construction, and which has a relatively large ink storage capacity.

Another object is to provide an improved capillary filler element formed from porous sintered metal.

Another object is to provide a writing instrument adapted to be filled either by dipping the writing point into a supply of ink or by inserting in the instrument an ink-containing cartridge.

Other objects and advantages of the invention will appear from the following description taken in connection with the appended drawings, wherein:

Figure 1 is a longitudinal sectional view of a preferred embodiment of my invention;

Fig. 2 is an enlarged, transverse, sectional view taken along line 2—2 of Fig. 1;

Fig. 3 is an enlarged, transverse, sectional view taken along line 3—3 of Fig. 1; and

Fig. 4 is an enlarged, transverse, sectional view taken along line 4—4 of Fig. 1.

Referring now particularly to Fig. 1, the ink-writing instrument includes a barrel or casing which preferably is formed by a forward barrel section 10 and a rear barrel section or end cap 11 detachably connected as by a threaded sleeve 12. While the barrel may be formed of barrel sections of nearly equal size, or with a long rear barrel section and a short forward barrel section, I prefer to employ a construction such as that illustrated. The barrel defines a chamber 13 adapted to receive a capillary filler element and an ink cartridge, both of which are described more in detail hereinafter.

A capillary filler and reservoir element is formed to provide a large number of interconnected spaces of capillary size, adapted to draw ink therein when placed in ink-feeding communication with a supply of ink and to retain the ink therein by capillary action except when the writing point is placed in contact with a writing surface.

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The capillary filler and reservoir element includes a plurality of disc-like members 14 formed of porous sintered material. Each of the members is formed with an annular rim portion 15 and a dished central portion 16 of generally conical form. The members 14 are so formed that they may be stacked, as illustrated in Fig. 1, to define between the rim portions 15 annular spaces 17 which are of capillary depth, thus providing a plurality of annular capillary ink storage spaces adapted to receive and store ink therein. Moreover, the porous metal from which the members 14 are formed has interconnected pores or spaces therein of capillary size also adapted to retain ink by capillary action. The pores in the members 14 communicate with and provide means interconnecting the several capillary spaces 17. Preferably, the pores in the members 14 are of slightly smaller size and therefore greater capillarity than the spaces 17 and thus ink will be drawn into the pores of the members 14 from the capillary spaces 17 and, since the members 14 are in firm abutment over substantial portions of their respective areas, a plurality of continuous interconnected columns of ink are formed in the stack of members 14. Excellent results have been obtained by making the pores in the members 14 of a size around 0.005" in wall-to-wall thickness and the capillary spaces 17 of slightly greater depth. The filler element members 14, as well as the writing element and feed element hereinafter described, is formed in the manner disclosed in my co-pending application Serial No. 45,823 filed August 24, 1948.

Each of the reservoir element members 14 is provided with a central air vent opening 18 and, when the several members 14 are disposed in stacked relation, the several air vent openings 18 thereof are substantially in alignment and define with spaces 19 between adjacent dished portions 16 an air vent passage extending longitudinally throughout the reservoir element. Thus, an air vent passage is provided through which air may pass during the filling or writing operations, as hereinafter described.

The barrel at its forward end is provided with a bore 20 adapted to receive and seat a writing element 21. The writing element preferably is formed of porous sintered metal generally similar to the metal from which the members 14 are formed and this element preferably takes the form of a hollow, elongated cup-like member open at its rear end and closed at its forward end. The forward end of the writing element 21 is

rounded, as illustrated, to provide a smooth writing tip.

The writing element 21 is connected in ink-feeding relation to the filler element by a feed element 23 having an enlarged head portion 24 disposed snugly in a reduced bore 25 extending forwardly from the chamber 13. The feed element 23 also has a reduced body portion 26 which extends forwardly through a reduced bore 27 and into the rear open end of the writing element 21. The body portion 26 preferably is of generally square cross-sectional shape but has rounded corners 28 which frictionally and firmly seat against the inner wall surface of the writing element 21. The feed element 23 is formed of porous sintered metal generally similar to that from which the filler element members 14 and the writing element 21 are formed. The feed element is firmly abutted at its rear face by the forwardmost reservoir element member 14 and, as previously explained, is also in firm contact with the writing element 21, whereby the pores in the feed element 23 serve to connect the pores of the forwardmost reservoir element member 14 with the pores of the writing element 21.

The writing element 21 is held against rearward displacement by a forwardly facing shoulder 30 and the feed elements 23 is held against forward displacement by a rearwardly facing shoulder 31, these elements being further retained against dislodgment by frictional engagement with the bores 29 and 25 respectively and by frictional engagement with each other.

The interior of the writing element 21 defines a space 22 which aids in providing a venting action, hereinafter explained more in detail, and additional venting is provided by air channels 32 formed between the straight side walls of the body 26 and the adjacent curved walls of the writing element 21. In addition, venting grooves 33 are formed in the forward end face of the enlarged head 24, which grooves extend radially outwardly from the juncture of the head 24 and body 26.

The pen of the present invention is adapted to be filled by capillary action, where such type of filling is desired. To fill the pen, the writing element is inserted in a supply of ink and ink rises by capillary action in the writing element, thence into the feed element and thence into the reservoir element members 14 successively from the lowermost to the uppermost. Ink also may enter the capillary spaces 17 defined between the peripheral portions 15 of adjacent members 14.

The present invention also provides means for filling the pen from an ink cartridge 40 by merely removing the rear end cap 11 and inserting the ink cartridge in the pen, whereupon ink flows from the ink cartridge into the reservoir element to fill the latter and is retained therein by capillary action until it is withdrawn in writing. One form of ink cartridge suitable for use in the pen of the present invention is illustrated in Fig. 1 of the drawing. The cartridge is removable from the barrel and is adapted to be filled with ink by the manufacturer and dispensed as a filled cartridge which may be inserted in the writing instrument by the user. The cartridge is so formed as to prevent ink from leaking therefrom when the cartridge is stored or shipped, but is adapted to be placed in condition for use by merely inserting it in the barrel of the writing instrument.

The cartridge 40 preferably includes a tubular casing 41, closed at its forward end by an imperforate, puncturable closure member 42 formed of rubber or equivalent material and suitably secured, as by an adhesive in the forward end of the casing 41, in such manner as to prevent leakage of ink from the casing so long as the closure member remains imperforate.

The rear end of the casing 41 is closed by a closure member 43 adapted to prevent ink from leaking from the casing, but at the same time adapted to permit air to enter the casing to permit ink to flow from the casing when the closure 42 is punctured. Preferably, the rear end closure is formed of porous sintered metal generally similar to that above described and having pores of such size as to permit air to pass therethrough but sufficiently fine to prevent ink from leaking from the rear end of the casing. The rear end closure is suitably secured in the rear end of the casing to prevent dislodgment during handling.

The interior of the casing 41 is vented through the rear end closure 43 and, when the cartridge 40 is in position in the barrel 10, the interior of the casing is vented to the exterior of the pen through a vent slot 44 formed in the metal sleeve 12 and a port 45 suitably located, as, for example, at the juncture of the barrel 10 and rear end cap 11. In order to insure the desired venting action, a seating element 46 is provided which takes the form of a disc of material similar to the rear end closure member 43. The disc 46 is snugly seated in the rear end cap 11 in position to be abutted by the rear end closure 11 when the cartridge 40 is assembled in the barrel 10 and the rear end cap 11 is in position.

Means are provided for puncturing the closure 42 and for permitting ink to pass from the cartridge to the filler and reservoir element, which means preferably takes the form of a channel element 50 having a tubular portion 51 and a head portion 52, with a bore 53 extending through both the tubular and head portions. The head portion 52 abuts the rearmost member 14 of the reservoir element and is adapted to itself be abutted by the forward end of the ink cartridge 40 when the latter is moved into its home position in the barrel. The head 52 is snugly and frictionally secured in the barrel 10 and serves to maintain the members 14 in abutting relation and also to maintain the forwardmost member 14 in abutment with the feed element 23. The rearward end of the tubular portion 51 is sharpened and adapted to puncture the forward closure member 42 to permit the rearward end of the tubular member to enter the interior of the casing 41 and to place the interior in communication with the exterior through a bore 52. Thus, when the cartridge 40 is moved into home position, the closure 42 is punctured and ink will flow from the cartridge into the chamber 13 forwardly of the head 52 and be drawn into the capillary spaces provided in the reservoir element to place the instrument in condition for writing.

It will be noted that a vent passage is provided through the bore 53, the interior of the casing 41, the rear closure 43, the seating member 46, the channel groove 44 and the port 45. Thus, air which is in the capillary spaces in the filler element, and which is displaced by the ink as it flows into the filler element, may pass upwardly through the central openings 18 in the reservoir element members 14 and bubbles up through the ink in the passage 52 and in the casing 41, and escapes through the rear closure 43 as above indicated.

In writing, when the forward end of the writing element is placed in contact with the writing surface, the capillarity thus established draws

ink from the writing element, and ink to replace the withdrawn ink is drawn into the writing element from the feed element, ink being drawn from the reservoir element into the feed element. Air to replace ink which is drawn from the reservoir element enters the instrument through the port 45 and passes through the slot 44 and through the cartridge casing 41, where a cartridge is employed, or through the rear end of the barrel where no cartridge is employed. The air then passes through the passage 52 and through the central openings 18 of the filler element members 14.

It has been found that where a porous capillary member of substantial wall thickness is employed, locking of the ink columns may occur due to the inability of air to enter the pores behind the ink, thus causing an uneven withdrawal of ink or even complete stoppage of the passage of ink, especially where the writing instrument is employed in rapid writing. In order to permit ink to pass readily along the spaces or pores in the feed element 23 and the writing element 21 to replace ink withdrawn from the latter in writing, the writing element, and preferably, also, the feed element, are so formed and arranged that there are no relatively thick cross-sectional areas therein and atmospheric pressure is applied to the surfaces of these elements on opposite sides of relatively thick wall portions. Thus, as ink is withdrawn from the writing element, air enters the pores and prevents any restriction on the passage of ink or "locking" which might otherwise occur were the feed element and writing element not thus vented.

The writing element is formed as a hollow member having therein a space 22 forwardly of the feed element, which space under normal conditions contains air at atmospheric pressure. A substantial portion of the exterior surface of the writing element is exposed and, therefore, it also is subjected to atmospheric pressure. The feed element is vented by the vents 32 and 33 above described.

Since air at atmospheric pressure is normally in contact with both the inner and outer faces, the ink in the pores of the writing element normally is under atmospheric pressure and, therefore, flows evenly along the pores as ink is withdrawn from the tip in writing. However, since air will enter the empty pores more rapidly than ink, some air may be drawn into the pores as the ink is withdrawn, some of this air being drawn in from the outside and some from the inside of the writing element. Air will normally find its way through the wall of the writing element at some point and thus maintain atmospheric pressure within the space 22. The feed element 23 is vented in a generally analogous manner inasmuch as the rear face is exposed to atmospheric pressure by way of the vent openings 18 in the members 14, and the forward face of the head and the side faces of the body of the feed element are vented by the passages 32 and 33, respectively.

A further aid to the venting action may be provided by forming the writing element with somewhat larger pores in the upper portion 21*a* of the forward end than in the lower portion 21*b*, which latter portion is normally adapted to contact the writing surface. Thus, ink will tend to be drawn into the smaller pores which have the greater capillarity and away from the larger pores, thereby permitting air to enter the interior of the writing element through the larger

pores. This difference in pore size may be provided by suitably forming the sintered metal member. Accordingly, during the molding of the powdered material prior to sintering that portion of the material which is to form the portion of the element having the pores of smaller size is compacted to a greater extent than the portion of the material which is to form the portion having the pores of greater size. When the molded material is sintered, the pores will be of a smaller size in those portions of the member which were more greatly compacted during the molding operation.

It will be seen from the foregoing that the present invention provides a writing instrument which is simple in construction and can be made relatively inexpensively. The several members which are formed from sintered material lend themselves readily to formation in the manner described and they may be assembled in the barrel without the exercise of unusual skill. Moreover, the construction of the instrument is such that there are no highly critical dimensions or tolerances and, therefore, the pen will operate even should slight departures from the desired dimensions occur during manufacture.

The writing element is of such form and so mounted that there is no likelihood of clogging of the ink flow passages by lint from the pocket of the user or fibers or sizing material from the paper with which the instrument is used in writing.

The instrument is adapted for use with conventional inks of the types commonly used in fountain pens and does not require any special type of ink for its operation. It may be filled by inserting an ink cartridge in the barrel, the cartridge being of such nature that it can be readily stored, shipped and dispensed and when inserted in the barrel automatically fills the reservoir element to place it in condition for writing. On the other hand, where a cartridge is not available or where it is preferred not to fill the pen in this manner, the pen may be filled by merely dipping the writing element in a supply of ink, whereupon the pen fills itself automatically by capillary action.

The venting action provides an even, controlled flow of ink to the writing element so that a uniform writing action is provided.

I claim:

1. A writing instrument comprising a barrel, a capillary filler and reservoir element in said barrel including a plurality of members formed from porous sintered metal, the pores of which are interconnected and are of capillary size and provide capillary ink storage spaces, said members being of generally disc form and disposed in a stack with portions of adjacent members mutually spaced and defining therebetween capillary ink storage cells of greater dimension than the ports in said members and communicating therewith, said pores and cells constituting the principal ink storage spaces of the pen, and a writing element connected in ink feeding relation to said filler and reservoir element.

2. A writing instrument comprising a barrel, a capillary filler and reservoir element in said barrel including a plurality of members formed from porous sintered metal, the pores of which are interconnected and are of capillary size and provide capillary ink storage spaces, said members being of generally disc form and disposed in a stack with portions of adjacent members mutually spaced and defining therebetween capillary ink

storage cells of greater dimension than the pores in said members and communicating therewith, each of said members being provided with an opening extending therethrough larger than said cells, said openings together providing an air vent passage extending through said filler and reservoir element, and a writing element connected in ink feeding relation to said filler and reservoir element.

3. A writing instrument comprising a barrel, and a capillary filler and reservoir element in said barrel including a plurality of members formed from porous sintered metal, the pores of which are interconnected and are of capillary size and provide capillary ink storage spaces, said members being of generally disc form and disposed in a stack with portions of adjacent members mutually spaced and defining therebetween capillary ink storage spaces of greater dimension than the pores in said members and communicating therewith, a writing element formed of porous sintered metal, the pores of which provide capillary ink feed channels, and a feed element formed of porous sintered metal, abutting said writing element and at least one of said members, the pores of said feed element providing capillary ink feed channels connecting the ink storage spaces of said filler and reservoir spaces with the ink feed channels of said writing element.

4. A capillary filler and reservoir element including a plurality of members of porous material arranged in a stack, the pores of which members are interconnected and provide capillary spaces, said members having central dished portions adapted to interfit and space the remainder and peripheral portion of each member from the adjacent members to provide a capillary ink storage space between adjacent members, said spaces being of greater dimension than said pores for enabling free and unobstructed flow of air therethrough.

5. A writing instrument comprising a barrel having an opening at its forward end and having its rear end vented to atmosphere, a capillary filler and reservoir element in said barrel for retaining ink therein by capillary action, a writing element connected in ink-feeding communication with said capillary filler and reservoir element and projecting through the forward end of the barrel and having a capillary passage for ink leading from the filler and reservoir element to the forward end of the writing element, whereby said filler and reservoir element is capable of being filled by capillary action through the writing element when the latter is placed in communication with a supply of ink, an ink cartridge adapted to contain ink, the capacity of said cartridge being not greater than that of said capillary filler and reservoir element, said cartridge being removably disposed in said barrel rearwardly of said capillary filler and reservoir element and having a puncturable closure at its forward end, and having means including a capillary element at its rear end for confining the ink in the cartridge but capable of admitting air into the cartridge, and a channel member between said filler and reservoir element and cartridge having a tubular portion positioned to extend through said puncturable closure when the cartridge is in position in said barrel to provide a passage for ink from the cartridge.

6. A writing instrument comprising a barrel vented at its rear end, a capillary filler and reservoir element in said barrel and consisting of porous sintered material and having an air passage throughout its length of greater dimension than the pores of the material, and a capillary writing element of porous sintered material of hollow shell-like form and having a closed forward end and including a defining wall element with pores distributed throughout and opening through the outer and inner surfaces thereof, said pores being in capillary ink feeding relation with said filler and reservoir element, said writing element having a substantial interior surface and having an exterior surface of substantial dimensions exposed through the forward end of the pen.

7. A writing instrument comprising a barrel vented at its rear end, a capillary filler and reservoir element in said barrel and consisting of porous sintered material, and a capillary writing element of porous sintered material in capillary ink feeding relation with said filler and reservoir element, said writing element being of tubular form with a closed end extending forwardly through the forward end of the barrel, said closed end having an upper and a lower portion with respect to a writing position whereby the lower portion is adapted to engage a writing surface in writing, the pores in said upper portion throughout the thickness of the element at that portion being of greater dimension and lesser capillarity than the pores in said lower portion, said pores of greater dimension providing passage for air from the exterior to the interior of the writing element.

8. A capillary filler and reservoir element including a plurality of members of porous sintered material arranged in a stack, the pores of the members being interconnected and providing capillary spaces, each member having an annular substantially flat peripheral portion and a central dished portion, the dished portion having a central flat portion on its outer convex surface and a central air passage through the dished portion of greater dimension than the pores of the material, said dished portions being interfitted when the members are stacked and being so shaped that the peripheral portions are mutually spaced apart to form capillary spaces of greater dimension than the pores of the material, and the central portions of the dished portions are mutually spaced apart to form central spaces of greater dimension than the pores of the materials, the central spaces and air passages forming a continuous air passage throughout the length of the filler and reservoir element.

9. A capillary filler and reservoir element including a plurality of members of porous material arranged in a stack with each of said members having a projecting portion abutting an adjacent member over a substantial area to space the remaining portions of adjacent members a distance such that the spaces are of greater dimension than the pores, said spaces opening through to the exterior of the filler and reservoir element, the pores of said members being interconnected and defining a capillary ink storage space in each member communicating in ink-feeding relation with those of abutting members and with the spaces between itself and such abutting members.

10. An ink storage member for a capillary filler and reservoir element comprising a generally disc-like member formed of porous sintered metal, the pores of which are interconnected and open through the surface of the member substantially throughout the area of the latter, said pores providing capillary ink storage spaces, said mem-

ber having a dished central portion and an annular substantially flat peripheral portion, said dished portion having complementally shaped concave and convex surfaces, the greatest transverse dimension of the concave surface being greater than the least transverse dimension of the convex surface.

11. An ink storage member for a capillary filler and reservoir element comprising a generally disk-like member formed of porous sintered metal the pores of which are interconnected and exposed throughout the surface of the member, said pores providing capillary ink storage spaces, said member being formed with an air opening extending therethrough of larger size than said pores, and having a plane portion and a second portion extending out of the plane of the plane portion, said second portion being so shaped on opposite sides that a plurality of identical said members can be stacked with the second portions inter-engaging and the plane portions mutually spaced apart, and with the air openings in alignment.

12. A writing instrument comprising a barrel, a capillary filler and reservoir element in said barrel including a plurality of rigid and porous members, the pores of which are interconnected and of capillary size and provide capillary ink storage spaces, said members being of generally disc form and disposed in a stack with portions of adjacent members mutually spaced and defining therebetween capillary ink storage cells of greater dimension than the pores in said members and communicating therewith, said pores and cells constituting the principal ink storage spaces of the pen, and a writing element connected in ink feeding relation to said filter and reservoir element.

13. A writing instrument comprising a barrel, a capillary filler and reservoir element in said barrel including a plurality of individual and separate stacked discs, each disc having pores of capillary size and the discs forming between abutting ones thereof pores of capillary size, and a writing element connected in ink feeding relation to said filler and reservoir element.

14. A writing instrument comprising a barrel having a reservoir chamber, a capillary filler and reservoir element in said chamber including a plurality of individual and separate discs, said discs being arranged transversely and stacked in the longitudinal direction of the chamber, said discs having outline size and shape substantially identical with the cross sectional size and shape of the chamber, adjacent ones of said discs abutting in mutual relation throughout at least a substantial portion of their transverse extent and the discs being supported in stacked relation by the abutment between the discs and substantially confined by the surrounding side walls of the chamber, each disc having pores of capillary size with at least certain ones opening through the abutting surfaces of the discs, and the discs forming between abutting ones thereof pores of capillary size defined by the open-sided pores in the respective discs, and a writing element connected in ink feeding relation to the filler and reservoir element.

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