This invention relates to a shower head and particularly to a shower head for domestic bath showers. Conventional shower heads now in use in domestic shower baths do not produce substantially clear, non-turbulent, directionally accurate and stable streams or jets of water. Instead, there is a wide variation in the consistency and cross-section of each individual jet at different times and at different locations along its length. Differences in water pressure and the resultant rate of discharge aggravate these variations in the consistency and compactness of the jet at different locations along its length and also variations in the degree of turbulence and in the overall direction of flow or discharge.

Generally, there are wide variations in the streams or jets relative to each other even when the water pressure is constant. For example, the jets differ from each other in cross section, they are differently aerated, all are turbulent and the turbulence of each is different from that of the others, they do not define a regular divergent pattern but instead are directionally unstable and irregularly directed. Very rarely do they maintain their compactness and clearness for any appreciable distance beyond their orifices but instead each tends to splutter, spread and break up into myriad small drops and lose its identity. Furthermore, such shower heads accumulate deposits of carbonates and foreign matter from the water line. These deposits fully or partially clog the orifices thus causing the orifices to discharge erratically.

Some of the conventional nozzles in use today include a spray cap which is provided with orifices which are distributed over its face in a regular pattern and which are arranged to diverge outwardly with respect to each other in the general direction of discharge, thus providing a wider pattern at the point of application on the body. In other the orifices are formed by a central plug having a serrated peripheral wall which is juxtaposed against a smooth surrounding peripheral wall of the body, the walls defining therebetween an annular row of orifices. In general, the orifices of these prior structures are more in the form of cylindrical passages or nozzles having an appreciable length. They are formed generally by drilling, broaching or like cutting operations. It appears that slight burrs or variations in surface condition inherently result from the machining operations and, while these often cannot be detected except with a strong magnifying glass, they are sufficiently large to change materially the characteristics of the stream of water which issues from the particular orifice or nozzle. causing turbulence, direction instability, and other variations. It appears that the most critical part of such an orifice or nozzle is its entrance end.

If the orifice or nozzle has appreciable length, another critical part is the passage between the entrance end and the discharge end. It is necessary for providing a smooth, parallel, non-turbulent and dimensionally and dimensionally stable flow that the inlet end of the orifice be extremely precise and that the passage through the orifice be such that its peripheral wall does not engage the jet or stream of water and interfere with it in any way during its passage from the orifice inlet through the outlet.

The principal objects of the present invention are to provide a simple and effective shower head which may be economically manufactured and serviced, which operates to discharge from the individual nozzles jets or streams of water which are clear, smooth, non-turbulent dimensionally stable in cross section, and directionally stable under all normal operating pressures.

Another object is to provide a means by which jets of different cross section may be provided to meet different conditions or desires of the user.

Another object is to provide a shower head on which the deposition of carbonates and foreign matter from the water is greatly reduced, and as to which particles or flakes of such deposits are prevented from reaching the shower orifices, or, if by chance they do reach the orifices, they can readily be cleaned and removed.

Another object is to provide a shower head having simple and effective orifices of which the inlet edges are circular and very accurately formed, and which are free from burrs, surface roughness, and the like, as a result of which cylindrical, substantially non-turbulent streams are discharged accurately directionally.

Another object resides in the provision of an orifice plate which may be formed in flat condition with a plurality of orifices in which the axes are parallel with each other but which, when installed, is warped so as to be concave toward the oncoming water as a result of which the axes of the orifices are divergent in the direction of flow of water therethrough.

Another object is to provide in the shower head a baffle means for reducing the turbulence and obtaining more nearly a smooth parallel laminar flow of the water preparatory to its entry into the orifices.

Another object resides in the manner in which the shower head is arranged so that the cap can be removed, the parts cleaned, different orifice plates installed selectively, and the parts effectively replaced in sealed relation so as to assure that all of the water entering the head reaches the orifices in a substantially non-turbulent condition.

Other objects and advantages will become apparent from the following description wherein reference is made to the drawings, in which:

Fig. 1 is a perspective view of the shower head embodying the principles of the present inventions;

Fig. 2 is a front elevation of the shower head illustrated in Fig. 1, taken in a direction axially of the head, part thereof being broken away for clearness in illustration;

Fig. 3 is a cross sectional view taken on the line 3-3 of Fig. 2;

Fig. 4 is an exploded view, partially in section, showing the various parts of the head illustrated in Figs. 1 through 3 and the order in which they are assembled; and

Figs. 5 and 6 are enlarged fragmentary cross sectional views illustrating modifications of the orifices or nozzles of the shower head.

Referring first to Figs. 1 through 4, the head comprises a hollow body 1 to which is secured an inlet fitting 2 which, in turn, is adapted to be secured to a fitting F of a suitable supply pipe I for supplying water into the body. In the form illustrated, the fitting 2 is shown as press fitted into the body 1.

The body 1 is provided at its outlet end with an axial bore 3 of large diameter and has coaxial bores 4 and 5 which lead, in succession, from the inner end of the fitting 2 to the bore 3. The bores 4 and 5 have side walls which are divergent in the direction of flow of the water. At its outer or discharge end, the body 1 is closed by a suitable detachable cap 6. The cap is detachably secured on the body by means of suitable cooperating lugs
7 on the cap and cooperating lugs 8 on the body. The lugs 7 and 8 are arranged so that the cap can be pressed against the open end of the body with the lugs out of registry and installed and drawn tightly against the outer end of the body by turning the cap through a very small angle about the axis of the bore 3. The cap 6 is provided with a plurality of passages 9 corresponding in position and number to the jets or streams of water to be discharged by the head.

The orifices 11 on the orifice plate 10 which is provided with a plurality of orifices 11. The plate 10 is installed at the inner face of the cap 6 with the orifices 11 in registry with the passages 9 of the cap. The orifices 11 of the orifice plate 10 are very precisely and accurately formed with smooth circular entrance edges. They are less in diameter than the passages 9.

In order to eliminate the possibilities of burrs or roughness on the entry edges of the orifices 11 or at any locations along their lengths, the orifices are preferably formed in the plate by punching. For example, the punch and its companion die should be very accurate, with a clearance of less than 0.0005 of an inch. The orifices are formed with the plate 10 flat and with their axes parallel to each other and at right angles to the plane of the plate. The diameter of each orifice preferably is about 0.027 of an inch for a fine jet and 0.040 of an inch for a somewhat coarser jet with the plate 10 preferably 0.10 of an inch or less in thickness, though the plate may be somewhat greater in thickness, if desired.

A suitable positioning pin 12 is provided in the orifice plate 10 and is adapted to engage a suitable socket 13 in the cap 6 for holding the plate 10 in the proper circumferentially rotated position about the axis of the cap. The cap is provided with an internal annular shoulder 14 which engages the periphery of the plate 10 so as to center it properly transversely of the cap.

As mentioned, it is critical that the inlet edge of the orifices 11 be precise and accurately formed and that they and the walls of the passages through the plate 10 be smooth and free from burrs. When so made, if water having a smooth or approximately parallel flow is forced against the inner face of the plate 10, it will issue through the orifices 11 as substantially clear, nonturbulent jets which are stable directionally and stable dimensionally in cross section. In order to obtain this effect, however, it is necessary that the jets be not disturbed by engagement with any extraneous obstruction after they issue from the orifices. Also, it is desirable that the jets diverge in a regular pattern.

Accordingly, the inner face of the cap 6 is made concave toward the oncoming stream of water in the head. Preferably it is made curvilinear or spherical, as illustrated. When the water is introduced against the back of the plate 10, the pressure of the water forces the plate against the inner concave face of the cap 6 and the plate 10 therefore becomes concave toward the oncoming water. This shaping of the plate 10 changes the direction in which the axes of the orifices extend with respect to each other, causing them to diverge away from the head.

The passages 9 in the cap are arranged so that it is much more economical to drill or mold a group of parallel passages than to drill them at divergent angles. However, the passages 9 are sufficiently large in cross section throughout their lengths so that, when their inner edges are coaxial with the orifices 11, the jets from the orifices do not impinge on the walls of the passage even though the passages 9 and orifices do not have parallel axes.

Each passage 9 must be of sufficiently small diameter so that the part of the plate 10 aligned therewith is held rigid and is not deflected or warped by water pressure. As mentioned, it is desirable that the water reach the orifices in as near a smooth, parallel flow, free from turbulence, as possible and further that foreign mater be prevented from reaching the orifices. Accordingly, an interponent 16 is provided. The interponent 16 is in the form of a disc and has a plurality of closely spaced passages 17 distributed uniformly radially of the disc, the passages 17 preferably being bisected by the head or inlet fitting 2. In order to assure that all of the incoming water passes through the interponent 16, the interponent is provided with an annular flange 18 at its discharge end. To provide an effective seal between the body 1 and cap 6, between the screen 25 and plate 10, and between the body 1 and the interponent 16, and the interponent 16 and plate 10, the interponent is provided with an external annular flange 19, the body, near its open end, is provided with internal flanges 20 and 21, and the cap is provided with an internal flange 22. These flanges are all positioned relative to each other so that a single O washer 23, of circular cross section, can be used for effecting a seal between the parts mentioned. As illustrated in Fig. 3, it is to be noted that when the washer 23 is pressed firmly into place by the cap 6 it engages the shoulders 19 and 20, thus providing an effective seal between the interponent 16 and body 1 so that water entering the body from the fitting 2 is constrained to pass through the interponent. Again, the O washer bears against the margin of the plate 10 thus providing an effective seal between the discharge end of the body and the interponent 16 and the interponent 16 and the plate 10 so as to constrain all of the water discharged through the interponent to pass through the plate 10. Further, the washer 23 effects a seal between the shoulders 19 and 20 of the body and the shoulder 22 of the cap 6. In order to reduce further and substantially eliminate any turbulence between the plate 10 and the orifices 11, the screen 25 is arranged on the inlet side of the interponent 16. The screen 24 is of fine mesh and may be one or more layers thick. It is sufficient to break up the localized lateral currents and turbulence and cause the flow of water approaching the passages 17 to be more nearly axially directed and more uniformly distributed radially of the interponent 16. Additionally, to reduce turbulence, the interponent is provided with a deflector 25 which is coaxial with the inlet passage of the fitting 2 and which is shaped at its inlet face to intercept the stream of water issuing from the fitting to deflect it as it passes between the inlet end of the body and outwardly toward the wall 4. The deflector 25 may be secured to the interponent 16 by means of a bolt 26 so as to form a part of the interponent and to hold the screen 24 in proper position. As mentioned, each shower head is provided with a plurality of plates 10 distinguished from each other by the size of their respective orifices 11. These plates can readily be removed for cleaning and the like or for changing to provide different sizes of jets.

It is desirable, however, to retain the interponent 16 and screen and washer in the head while changing the plates 10. For this purpose spriite clips 27 are provided. The clips 27 are secured in suitable grooves 28 in the side of the interponent 16 and are fastened in place by means of rivets 29. Each clip has a raised shoulder 30 near its inner end so arranged as to frictionally press firmly against the inner wall 31 of the body 1 and frictionally secure the interponent in place therein. At its outer end each clip is provided with an outwardly concave holding portion 32 which is adapted to engage the washer 23 and hold it firmly against the shoulder 21 of the body. In the form illustrated, two such clips 27 are shown but, if desired, more can be disposed about the periphery of the interponent. The clips hold the interponent snugly in place against the forces of gravity but with a force so limited that the interponent can be forced out of the body by pressure of the water when the water is turned on to provide a substantial flow with the cap 6 removed.
In operation; the cap 6 is removed; and the plate 20 with the desired size orifices is installed in the cap, being centered therein by means of an annular shoulder 14 and properly positioned circumferentially of the cap by the pin 12 engaging the socket 13.

In this condition the orifices 11 of the plate 10 are aligned with the passages 9 in the cap 6. The cap is then pressed against the body, and a 1 and given a turn of a few degrees, whereby the lugs 7 and 8 draw it firmly into sealing engagement with the washer 23. This secures the cap 6 in place and places the washer 23 under sufficient stress to prevent leakage between cap and body and to assure that all water entering the body passes through the screen 24, the passages 17, and the orifices 11 of the plate 10 while at the same time preventing any of the water from passing otherwise from one side of the interponent to the other or from one side of the plate 10 to the other.

The washer 23 is sufficiently yieldable and resilient so that it does not prevent the slight radial movement of the margin of the plate 10 as pressure of the water deflects the plate 10 and warps it in firm contact to face juxtaposition with the inner face of the cap 6.

The water reaches the inner face of the plate 10 in an approximately smooth parallel or laminar unidirectional flow parallel to the axis of the body. Since the inlets of the orifices 11 are accurately formed, the water is divided into a plurality of jets which pass from the inlets of the orifices 11 out of the outlets of the passages 9 without touching the walls of the orifice passages 11 or of the passages 9. These jets are relatively clear as they leave the head 1. They strike the body of the user of the shower, under normal conditions, as well defined, relatively solid, high velocity streams which are accurately directed. As a result, a very effective and forceful needle-like effect is produced.

If desired, instead of the orifice plate described, modified forms of the cap may be used, as illustrated in Figs. 5 and 6, respectively.

In Fig. 5 there is shown a cap 33 which is similar in general to the cap 6 heretofore described. However, instead of the passages 9 the cap 33 is provided with a plurality of individual nozzles. Each of these nozzles is in the form of a short tube 34 which is firmly secured to the cap 33 and is open at one end on the inside of the cap. Each tube 34 extends beyond the outer face of the cap and is provided at its outer end with an individual orifice plate 35 having an orifice 36 therein. The orifice plate 35 may be an integral part of the tube 34, or, if desired, it may be a separate plate in which latter case a suitable sealing cap 37 may be permanently secured to the outer end of the tube 34 for holding the orifice plate in place. Each tube has a passage 38 of sufficient diameter so that the jet issuing from the orifice 36 does not strike the walls of the passage 38. In this form of the invention, if different sizes of jets are desired, separate caps, each with different orifices or nozzles, are provided.

In Fig. 6 there is illustrated a cap 40 similar to the cap 6 except that the passages 41, instead of extending entirely through the cap terminate near the inner face of the cap and a thin integral web 42 is left at the base of each passage 41. This web provides, in effect, an integral orifice plate for its associated passage 41. The web, in turn, is provided with an orifice 43. This modification is not as desirable as the preferred form of the invention described in connection with Figs. 1 through 4 in that directional punching of the orifices 43 is required as each orifice has its axis divergent with respect to the axes of the orifices in the direction of discharge. Furthermore, most of the orifice is improperly made during manufacture, the entire cap must be scrapped.

It is apparent from the foregoing description that the shower head described is very effective, provides clear jets which are stable dimensionally in cross section and directionally, and which are substantially free from turbulence. The shower head can be made very economically. The orifice plate 10 may be made of any thin material, such as stainless steel copper, brass, or the like, or organic plastic material, such as is commonly termed "plastics." The plastics are particularly desirable, not only for the plate 10 but for the body, interponent, and cap, in that the tendency for carbonate deposits thereto is greatly reduced or eliminated. If deposits are formed, they can be removed more readily from plastics than from metal.

Several advantages result from making the plate 10 very thin. First, the orifices can be formed more accurately therein. Also, the length of the passage from the inlet to the outlet of each orifice is so short that it is almost impossible for foreign matter to lodge in them and danger of impingement of the jet against the passage wall is eliminated. Furthermore, a thin plate can conform to the curvature of the rear face of the cap 6 at lower water pressures than can a thick plate.

Having thus described my invention, I claim:

1. A shower head comprising a hollow body adapted for connection to a shower bath water supply pipe and having an inlet passage and a discharge passage, a cap covering the outlet of the discharge passage and having a multiplicity of passages therethrough from its inner face to its outer face, an orifice plate of thin relatively stiff but flexible sheet material overlying the inner face of the cap and having a plurality of water jet orifices therein which have smooth entering edges and which are aligned with the passage of the cap, the cap passages being sufficiently greater in cross section than the orifices so that the jets from the orifices, at shower bath water supply pressures sufficient to cause the water to issue as jets from the orifices, respectively, can pass through associated passages in the cap free from contact with the peripheral wall of their associated passages in the cap, said plate and cap being readily detachable from the body, the inner face of said cap being in the form of a shallow concavity, said plate being normally flat and unflexed, the axes of the orifices being parallel to each other when the plate is flat and unflexed, the plate being sufficiently flexible to be flexed by said household water pressure, while the plate is mounted in the body, outwardly against the inner face of the cap and become concave inwardly of the body when the shower head is in operation, whereby the axes of at least some of the orifices become divergent from each other in a direction away from the body.

2. A shower head comprising a hollow body adapted for connection to a shower bath water supply pipe and having an inlet passage and a discharge passage, a detachable cap covering the outlet of the discharge passage and having a multiplicity of passages therethrough from its inner face to its outer face, an orifice plate of thin relatively stiff but flexible sheet material overlying the inner face of the cap and readily detachable from the body and having a plurality of water jet orifices therein which have burlureless, smooth entering edges and which are aligned with the passages of the cap, said orifices being respective to the passages in the cap, the cap passages being sufficiently greater in cross section than the orifices so that the jets from the orifices, at shower bath water supply pressures sufficient to cause the water to issue as jets from the orifices, respectively, can pass through associated passages in the cap free from contact with the peripheral wall of their associated passages in the cap, said orifice plate being so formed and the entry edge of the orifices being so sharp that each jet, under the said pressure of a shower bath water supply, in passing through its orifice, remains out of contact with the peripheral wall of its orifice from the outer surface of the plate substantially to the inner surface of the plate, and out of contact
with the peripheral walls of the cap passages, and extends axially of its orifice for a material distance beyond the cap, and baffle means interposed between the inlet passage and the innermost face portions of the plate for causing the water to reach the orifices with a direction of flow predominantly endwise of the orifices, thereby to reduce the turbulence in the jets.

A shower head comprising a hollow body adapted for connection to a shower bath water supply pipe and having an inlet passage and a discharge passage, a readily detachable closure means detachably connected to the body and covering the outlet of the passage, said closure means having jet passages therethrough, orifice plate means of thin, relatively stiff, flexible sheet material at the inner face of the cap and overhanging the margins of the inlet ends of the jet passages, said orifice plate means having water jet orifices therethrough, each orifice having a smooth entering edge, said orifices being related to the jet passages so as to be operable at household water pressures sufficient to cause the water to issue as jets from the orifices, respectively, to discharge jets of water through the jet passages, respectively, in spaced relation to the peripheral walls of the associated jet passages, and readily removable baffle means removably secured in the body and located between the inlet passage and the surface portions of the orifice plate means which are interposed at a direction endwise of the body, for causing the water to flow to the innermost face portions of the orifice plate means generally axially of the orifices so as to reduce turbulence in the jets issuing from the orifices.

A shower head according to claim 3 characterized in that said orifice plate means is of organic synthetic plastic whereby the deposit thereon of soot from the water is reduced.

A shower head comprising a hollow body member adapted for connection to a shower bath water supply pipe and having a single discharge passage, a cap member detachably connected to the body member and covering the inlet of the passage, and a plurality of jet passages therethrough, an orifice plate in the form of a single sheet of thin, stiff, flexible sheet material detachably interposed between the body and cap member and covering the outlet of the discharge passage, said plate being sufficiently flexible to be flexed by shower bath water supply pressures which are sufficient to cause the water to issue as jets from said orifices, respectively, said plate having a plurality of circular water jet orifices therethrough, each of said orifices having an accurate, smooth, burrless, edge at its inlet end, said body having an annular Sealing area about one end, said body having an annular sealing area alongside the sealing area of the disc, and a single O ring seal engaging all of said annular sealing areas and margin and held by the cap in sealing relation thereto, and thereby constraining all water to discharge through the orifice plate in a condition substantially free from turbulence.

A shower head comprising a hollow body adapted for connection to a shower bath water supply pipe and having an inlet passage and a discharge passage, a readily detachable cap covering the outlet of the discharge passage, and having a multiplicity of passages therethrough from its inner face to its outer face, an orifice plate means of thin, relatively stiff but flexible sheet material overlying the inner face of the cap and readily detachable relative to the body and having a plurality of water jet orifices therein which have smooth entering edges and which are aligned with the passages of the cap so as to discharge therethrough, the cap passages being sufficiently greater in cross section than the orifices so that the jets from the orifices, at shower bath water supply pressures which are sufficient to cause the water to issue from the orifices as jets, respectively, can pass through the associated passages in the cap, baffle means interposed between the inlet passage and the orifice plate and spaced from the orifice plate for reducing the turbulence of the stream of water at the valve edge of the baffle means as compared to the stream at the inlet side of the baffle means for causing the water flowing to the orifices to reach the orifices with a direction of flow predominantly endwise of the orifices, thereby to reduce the turbulence in the jets issuing from the orifices.

A shower head comprising a hollow body adapted for connection to a shower bath water supply pipe and having an inlet passage and a discharge passage, a readily detachable cap covering the outlet of the discharge passage, and having a multiplicity of passages therethrough from its inner face to its outer face, an orifice plate of thin, relatively stiff but flexible sheet material overlying the inner face of the cap and readily detachable relative to the body and having a plurality of water jet orifices therein which have smooth entering edges and which are aligned with the passages of the cap so as to discharge therethrough, the cap passages being sufficiently greater in cross section than the orifices so that the jets from the orifices, at shower bath water supply pressures which are sufficient to cause the water to issue from the orifices as jets, respectively, can pass through the associated passages in the cap, means interposed between the inlet passage and the inner face of the orifice plate for causing the water flowing to the orifices to reach the orifices with a direction of flow predominantly endwise of the orifices, and thereby reduce the turbulence in the jets issuing from the orifices, said means including a disc having an annular seating area about one end, said body having an annular seating area alongside the seating area of the disc, and a single O ring seal engaging all of said annular seating areas and margin and held by the cap in sealing relation thereto, and thereby constraining all water to pass through the baffle means entroute to the inlet side of the orifice plate and to discharge through the orifice plate in a condition substantially free from turbulence.

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