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Design of Volute Siphon
N. S. Govinda Rao

DESIGN OF VOLUTE SIPHON (*)

N.S.GOVINDA RAO

B.E., A.M.I.E., Professor,
Indian Institute of Science. Bangalore

1. INTRODUCTORY

The siphon spillway is a useful device for disposal of surplus from reservoirs. Unlike gates, it is automatic in action, has practically no maintenance cost and is leak proof. Compared to the method of allowing surplus to flow over a dam, a siphon can discharge very much more per foot length of dam. As an example it may be mentioned that for such siphons the depth above full reservoir level for priming at Hirebhasgar Dam is 1.5 feet while it has been calculated that depth of overflow, for an equal length of dam occupied by the siphons, to pass the same discharge would have been 19 feet. This device thus reduces waterspread area coming under submersion. Its cost of construction compares favourably with other spillway devices. It can also suck out sediment from the bed of a reservoir when it is in action during floods.

In India the first use to spill surplus from a large reservoir by means of siphons appears to have been made at Marmacelli in 1921 where saddle type siphons were constructed for the purpose. Due

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(*) La conception des siphons a volutes.

to the various limitations in the working of the saddle type of siphon, it did not become popular.

It was left to the genius of Sri V. Ganesh Iyer, an eminent engineer of the Mysore State to discover an altogether new method of approach to this problem. In the type evolved and designed by him, the siphon can utilise fully the head due to the difference of water level up and downstream of a dam in producing discharge.

Sri V. Ganesh Iyer started working on the design of this siphon in 1933-34 and was able to instal a few of them at Marconahalli in 1938. Sri M. Narasimhaiya, now retired Chief Engineer of Mysore was the pioneer in their construction. These siphons were 8 feet in diameter and worked under an operating head of 43 feet. Siphons of 18 feet diameter operating under a head of 58 feet have been installed at Hirebhasgar (Figure 1).

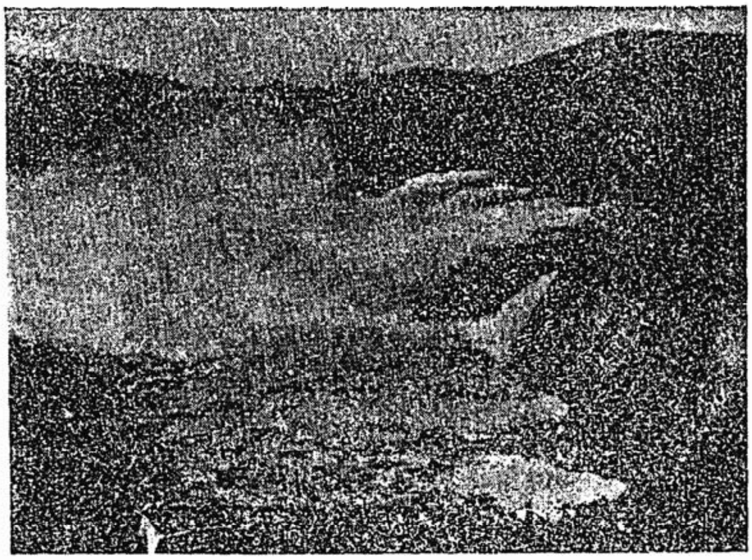

Fig. 1.

Showing siphons in action at Hirebhasgar.

2. WORKING OF A VOLUTE SIPHON

The Volute Siphon consists essentially of a dome with a funnel placed underneath, leaving an annular space alround, with a vertical pipe taken down the funnel, to pass the discharge through the dam. The various parts are shown in figure 2.

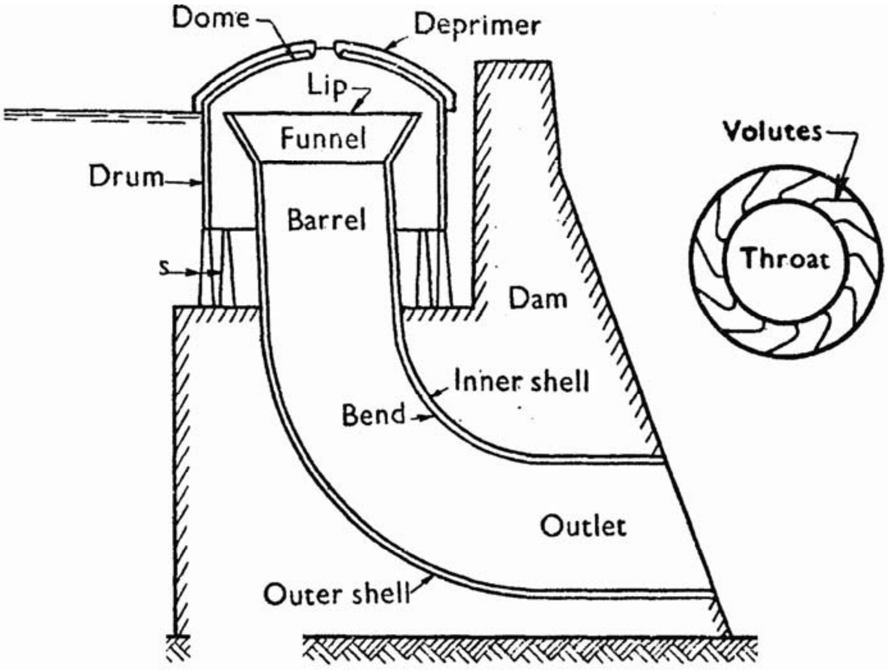

Fig. 2.

The lip of the funnel is kept at F.R.L. of the reservoir and a number of volutes (like the blades of a centrifugal pump or a turbine) are placed on the funnel to induce a spiral motion to the water passing along them. The dome is built over a cylindrical drum resting on pillars, leaving an annular space around the funnel. The vertical pipe or barrel taking down from the funnel is bent through a right angle so as to lead the discharge away from the dam.

When the water in the reservoir rises above F.R.L. it spills over the circumferences of the lip of the funnel, skirts along the volutes, and at the throat falls into the barrel forming a water seal turning with a spiral motion. The air in the siphon trapped between the inlet and the water seal is evacuated by any or all of the following processes:

(a) Dragging in of air at the surface of water flowing along the funnel and forming the boil in the barrel.

(b) Screwing out air due to the spiral motion given to the water filaments by the volutes in the siphon.

(c) Air being dragged by spray of water formed due to the turbulence set up by the impinging of water filaments against one another and against the tip of the neighbouring volute. The angle of take off of the volutes is such that a portion of the flow from one volute can impinge against the tip of the other volute forming a series of ribbon like filaments which spray out.

(d) By physically trapping in air in pockets formed due to different angles of throw off of the filaments of water at the throat.

The above is explained in the description given below of how priming takes place:

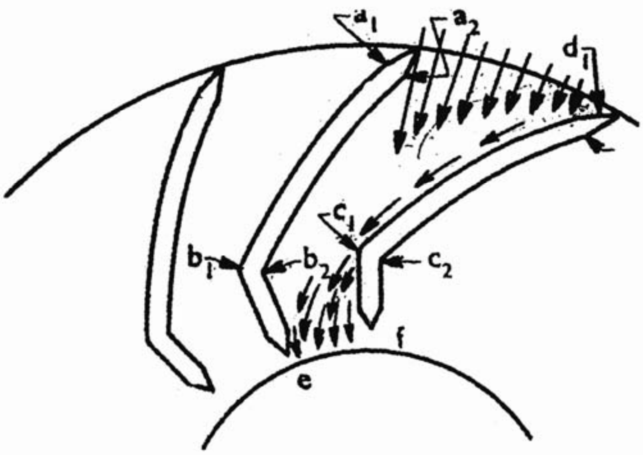

Fig. 3.

As the water overflows the lip of the funnel, it enters in the space between the volutes a_2 d_1 (Figure 3) and flows radially along the slope of the funnel, heaping up along the outerside d_1 c_1 of the volute up to the point c_1. While continuing to flow in the same direction towards e, a portion of the flow is pulled down the slope of the funnel with the result it gets spread out fanwise in the space ef. The portion which strikes the tip e issues forth in a thin ribbon like filament (vide Figure 4).

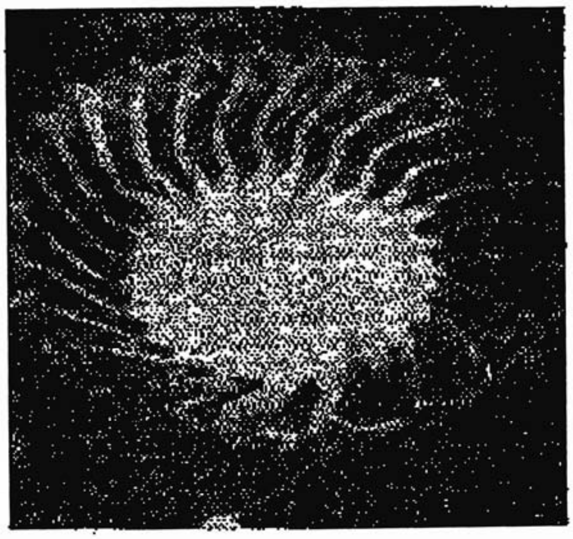

Fig. 4.

These fanlike layers of water in the spaces between the volutes are thrown out into the barrel ending in a boil. Due to the different radial and circumferential components of the velocities induced in the filaments of the fan-like flow due to the varying lengths of path each has to traverse before it takes off at the throat, the fan like flow is not in one horizontal plane but is tilted. If there are twenty four volutes, there will be such twenty four tilted fan-like layers like the petals of a flower. Air is trapped in between these tilted fan like layers.

As the air is dragged down in all the four ways mentioned above, the pressure above the water seal portion begins to fall. As the depth of the drum is kept generally very high, there is no possibility of air getting in from the reservoir side to make up for the fall in pressure. The air, therefore, enters from behind the outlet and rushes to the dome to make up the fall in pressure as long as the water seal is too thin to resist its being punctured through. When the air is thus trying to enter from behind, there is a rise in the boil point. If it gets punctured it falls through again. There is thus for a time a pulsation of flow, the boil in the barrel moving up and down. As soon as a sufficiently strong water seal is established with the necessary rise in reservoir level this movement of boils up and down ceases, and the strength of the vacuum begins to increase steadily. Since at this stage air can no longer enter from behind, more water from the reservoir side is pushed in due to the increasing difference of atmospheric pressure in and outside the annular space in the siphon. As more water enters, the sucking action becomes more powerful, resulting in a further entry of water which in turn creates a greater vacuum. This chain reaction develops rapidly and in a few moments the siphon runs full. To start this chain reaction, a difference in pressure equal to only 1 1/2 feet head of water between inside and outside the water seal is sufficient. In the Hirebhasgar siphons which are probably the World's biggest siphons and which have a dome 38 feet in diameter, siphonic action started within ten minutes of the commencement of its priming.

During depriming, the reverse action takes place when air starts entering through deprimers.

3. FACTORS EFFECTING PRIMING

Factors on which priming in a volute siphon depends are the following:

(a) *Rate of rise of reservoir level:* In the Hirebhasgar reservoir which is a lake 25 square miles in extent at its F.R.L. and has a capacity nearly 30,000 million cub feet, the rate of rise of reservoir level did not affect priming depth (1).

(1) "Behaviour of Siphons", Annual Report of the Hydraulic Research Station, Krishnarajasagar, for the year 1948.

(b) *Proportion of diameter of siphon to operating head:* This is given by the formula (2).

$$H = D\left(\frac{1}{2n} + K + \frac{1}{2}\right) + \frac{D^2(1 + n^2)}{16\, n^2 c_v^2 (d + d_1)} + d$$

where d == height of funnel,

d_1 ==Priming depth,

Slope of funnel== one vertical to n horizontal,

D == diameter of barrel,

K== ratio of the radius of the inner bend to the diameter of the siphon,

H == Height of funnel lip from centre of outlet,

C_v== Coefficient of velocity.

The diameter should be such that all the filaments of flow falling along the slope of the funnel can meet in a boil within the barrel portion.

(c). *Number and shape of volutes.*

(d) *Rise and diameter of dome.*

(e) *Slope and height of funnel.*

(f) *Radius of the outlet bend.*

(g) *Length of outlet.*

(h) *Extent of submergence of outlet in the tail water.*

No mathematical relationship could be worked out between priming depth and diameter of siphon. Experiments have however shown that other conditions remaining constant, priming depth decreases with the diameter of a siphon for a given operating head. The importance of the other factors in regulating priming is discussed while describing the individual parts of the siphon.

4. CALCULATION OF DISCHARGE

After a siphon has primed, the flow in it is similar to the discharge of any liquid under pressure in a pipe. The energy causing the flow into a siphon is that due to the atmosphere.

(2) Annual Report of the Hydraulic Research Station for the year 1947.

Let: ABC be a cistern with water level at A and an orifice at C of area a (Figure No.5). Let H be the head of water from A to BC.

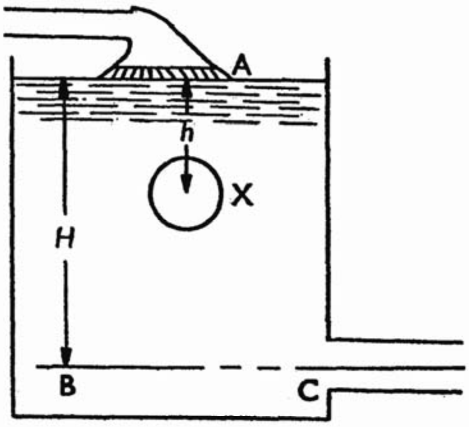

Fig.5.

Let X be any point in the cistern, head "h" feet below the free water surface A. Let P be an arrangement to supply water to the cistern. Let the maximum velocity with which water can discharge at C be $\sqrt{2gH}$ feet per second and the discharge q cusecs and the energy required to produce this discharge be E. As long as the energy added at P is equal to the energy lost at C, the water level remains constant at A. As long as the energy input and output balance each other, *water in the cistern itself* does not work. This can be easily seen by applying Bernoulli's equation.

At any point X,

Kinetic energy head .... = E (added at P)
Pressure energy head .... = h
Static energy head .... = H−h

Total .... = E + H

It is the same at B or C.

The sum total of the energy to be added at the inlet of the Cistern should be $\frac{w\,a\,v^3}{2\,g}$ foot pounds per second to produce a velocity of v feet per second in an orifice of "a " square feet area at C.

The velocity V and area A of the feeding water supply pipe at P can be anything as long as the energy it gives is equal to $\frac{w\,a\,v^3}{2\,g}$ foot-pounds per second. Instead of a water supply pipe at P, the atmospheric head does this work by creating vacuum conditions in a siphon. The maximum velocity which the atmosphere can generate, after allowing for friction and other losses may be taken as 40 feet per second equal to 25 feet head of water. The area of the inlet to the siphon that is the annular area is so designed that without exceeding this 40 feet per second velocity, the energy of the flow at the annular space is equal to or slighty more (to make up for friction losses) than the energy of the flow at the outlet of the siphon. As long as this is done, the discharging capacity of the siphon will be that due to the area at the outlet operating under a head equal to the difference of level between the reservoir level at the time of priming and the centre of the outlet. If the outlet is submerged in the tail-water, then the tail water level has to be considered.

In siphons whose operating head is above that of the atmosphere i.e. 34 feet, negative pressures occur at the throat. Applying Bernoulli's theorem (Figure 6) we see that

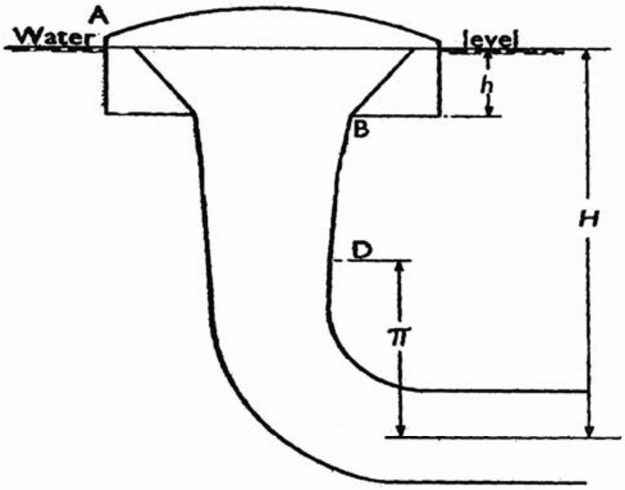

Fig. 6

at A at B at C

$$\pi + H = \frac{V_1{}^2}{2g} + H - h + \frac{p_1}{w} = \frac{V_2{}^2}{2g} + o + \pi \qquad (1)$$

Where π is the atmospheric pressure.

p_1, v_1, h_1 are the pressure and velocity and head below reservoir level at the throat at B.

v_2 is the velocity at the centre of outlet at C.

From equation (1) we get

$$h = \frac{p_1}{w} - \pi + \frac{V_1^2}{2g}$$

As long as the diameter of the barrel is kept uniform v_1 and v_2 will be the same, and also from equation (1)

$$H = \frac{V_2^2}{2g} \qquad (2)$$

so that

$$h = \frac{p_1}{w} - \pi + H$$

or

$$\frac{p_1}{w} = h + \pi - H \qquad (3)$$

If cavitation pressures are to be avoided at B, which incidentally is the point of maximum negative pressure in the barrel, the sum total of the atmospheric head and height of tunnel (i.e. the portion with varying diameters) should not be less than the operating head, or in other words the net height DC of barrel above the centre of the outlet which can have a uniform diameter should be less than that which can cause a cavitation pressure. Generally it may be taken as 25 feet plus the head loss in friction in the barrel. The portion of the barrel above it should have a diameter varying with the increase in velocity due to gravity head. In such a design there will be no point within cavitation pressure and at the same time the pressure due to the atmosphere is made use of to a maximum extent in adding to the velocity of discharge from the point D donwards.

Subject to the above limitations, the discharge Q in the volute siphon is:

$$Q = CA\sqrt{2gH}$$

Where C=Coefficient of discharge,
A=Area at the outlet,
g=Acceleration due to gravity,
H=Operating head.

The coefficient of discharge depends on the losses at entry, at the volutes, at the bend, in the barrel, outlet, etc. In models, a coefficient as high as 0.90 has been realised.

In actual working it is not pure water that will be passing down the siphon but a mixture of air and water. In addition a certain amount of air is pushed in by the vortices formed around. These cause diminution of negative pressures so that in actual practice the level D can be much higher without cavitation pressures occurring. In fact it must be placed higher if the full efficiency of the siphon has to he realised. The theory of the vortex flow as developed by Helmholtz and Kelvin applies equally to the siphons. Regarding application of Bernoulli's theorem for calculation of pressures it should not be forgotten that this theorem is applicable only to a streamline which is steady and the flow is irrotational. On account of the turbulence created by the volutes in creating spiral movement, and the unsteady conditions of reservoir levels, it may be more rational to consider pressure, conditions from an analysis of the variations in the energy of a particle which takes place during its passage through the siphon.

5. PARTS OF A VOLUTE SIPHON

The parts of a Volute Siphon are :-

(a) Dome, (b) Drum, (c) Pillars, (d) Funnel, (e) Volutes, (f) Vertical pipe or Barrel, (g) the Bend, (h) Outlet, and (i) Deprimers.

The diameter of the dome is fixed by the annular space and the diameter at the lip of the funnel. The pressure for which it has to be designed to withstand is the difference between the pressure that actually occurs inside the dome and the atmospheric pressure outside. The negative pressure that actually occurs inside the dome is a function of the velocity designed to occur at the annular space at the inlet to the funnel. The rise of the dome should be as small as possible and the intrados quite smooth. A high dome harbours air pockets. The dome should be placed truly above the funnel as model experiments conducted at the Hydraulic Research Station Krishnarajasagar have revealed that even the slightest eccentricity may alter the efficiency of a siphon.

The height of the drum should be as high as possible leaving enough waterway between its bottom and top of the platform on which it is housed, to feed the siphon freely. A high drum minimises strength of the vortex by lengthening its path thus making it difficult for logs of wood and other floating debris on the reservoir to be sucked inside. It minimises interference effects when siphons are placed close together in a battery. It also facilitates desilting.

The number and diameter of pillars supporting the drum should be a minimum consistent with their strength to minimise obstruction to flow.

The design of the funnel is such as to introduce as high a boil point as possible in the barrel. A high funnel will throw out water at the throat with an initial velocity which aids in better screwing of air which facilitates earlier priming. A high funnel also reduces the regions below the throat over which cavitation may take place. The optimum slope for the highest boil condition is given by the equation

$$y = \frac{D}{2}\sqrt{\frac{2D}{8D_1 - 6D}} + \frac{D(2D_1 D - D^2)}{4(D_1 - D)\sqrt{4DD_1 - 3D_1}}$$

Where D = Diameter of the funnel at the throat,
D_1= Diameter of the funnel at the lip,
y = Height of boil below the throat.

The diameter of the lip cannot be increased indefinitely as the intensity of discharge that can be passed per foot length of spillway gets decreased. It may not be possible to pass the maximum flood within the spillway gap available. A steep slope of funnel increases the volume of the water seal and, therefore, of the air to be sucked out. But the velocity of flow is also increased and with it its capacity to drag out air. The choice of the slope and height of funnel has, therefore, to be made taking all the, factors mentioned above into consideration.

The design of the volutes governs to a large extent the efficiency of priming. This depends on the number, height, shape and orientation of the volutes. The volute has two parts. For a portion of the height from the lip to the throat a_2 b_2 (vide Figure 3) it is straight taking off from such an angle which will give a good circumferential velocity to the flow. At the bottom portion b_2 e it is radial that is directed towards the centre of the barrel so that the flow will acquire a radial component to the velocity so that it may fall towards the centre, meet other filaments of flow from neighbouring volutes and form a water seal. As the length a_2 b_2 increases the strength of the vortex to suck in air increases. The length b_2 e becomes correspondingly less decreasing the radial component of the velocity and, therefore, the strength of the water seal to resist the puncturing action of the air from outside (2).

By adjusting the lengths a_2 b_2 and b_2 e it is possible to produce a water seal with maximum vortex strength. The greater the number of volutes, the lesser will be the priming depth up to a certain optimum limit with a corresponding decrease in the coefficient of discharge. The height of volutes should necessarily be not less than the expected priming depth to prevent interference of flow between one pair of volutes and another. Regarding the section of the volutes, its sides are kept normal to the plane of the funnel with the top edge rounded off to offer least obstruction to flow. Their ends are cut sharp like the cut waters of a bridge. Owing to their thickness which is necessary for their stability, it is necessary to end them a distance above the throat to ensure sufficient space for the flow to cover the thickness of the volute so that all portion of the funnel at the throat portion are covered with a fllm of water.

The length of the barrel gets fixed by the height of the funnel provided at the top and the radius of the bend at the bottom. In the regions where the pipe is subjected to pressures below the atmosphere, its diameter can be made uniform. Above this level the diameter has to be varying if cavitation effects are to be avoided. These remarks apply to high head siphons.

As regards the bend connecting the barrel with the outlet, model experiments have shown that priming depth is a minimum

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(2) Annual Report of the Hydraulic Research Station, Krishnarajasagar, for 1947.

with sharp bends while the coefficient of discharge is greater in the case of easy bends. The priming depth can also be reduced by increasing the angle of bend to give an upward tilt at the outlet (3). The pool of water formed in a tilted bend, no doubt, retards the velocity of discharge causing reduction in the coefficient of discharge. But the reduction in coefficient is not very much and in many cases it may be worth while to suffer this disadvantage to gain large reduction in priming depth. Regarding the ratio of radius to centre of bend and diameter D of pipe i.e., R/D ratio, it should be noted that the descending discharge in the barrel is a mixture of air and water and not water alone. When it impacts on the floor, the dissolved air escapes and tries to accumulate and form an air pocket at the top. This tendency is more pronounced in an easy bend than in a sharp bend (4). The frictional losses are more in the latter. Still it is better to use the sharp bend as loss in discharge due to accumulation of air pockets is more than that due to friction losses.

The minimum length of outlet required is that at which all the filaments deflected at the bend can regain their straight paths. This will ensure a full bore discharge maintaining pressure flow conditions. Unnecessary increase in length increases friction losses, while short lengths cannot favour formation of full bore discharges. Regarding the shape of the outlet exit, model experiments under low heads have shown that flaring increases discharges by as much as 39 % (5). In experiments carried out at Poona with the prototype flaring increased discharge by only 3 % (6). Flaring also created cavitation pressures. Experiments conducted at the Krishnarajasagar Research Station (7) have shown that when the outlet exit is given shapes (square or elliptical) other than circular, even after making the transition from the circular section of the bend to exit section quite smooth and gradual, and keeping the cross sectional area constant throughout, these changes cause considerable reduction in coefficient of discharge, due to loss of energy caused in the changing geometry of the flow formation of eddies, and air pockets. The position of the invert of the outlet depends on the nature of protective works possible downstream. For minimum priming depth it is best kept such that the submergence ratio is 0.95 (That is the ratio between the diameter of the outlet and the depth of water above the invert of the outlet at maximum tail water level which occurs when the siphons are about to prime). This small clearance will give space for air to escape from the barrel while air is being pushed out during priming.

(3) Annual Report of the Irrigation Research Division, United Provinces 1945.

(4) Proceedings of the Institution of Civil Engineers. Volume 231.

(5) Institution of Civil Engineers. Volume 224.

(6) Annual Report of the Indian Waterways Experimental Station, Poona for 1946, 47, 42-43 and 39-40.

(7) Annual Report of the Hydraulic Research Station, Krishnarajasagar for 1947 and 1948.

In a tilted outlet, an additional water seal is sought to be created at the bend. It is possible that the air may he locked up between the two water seals and create unnecessary turbulence throughout the siphon. If we keep the outelt under a high ratio of submergence the effect of priming will be only at the top. By this arrangement the entry of air from behind is restricted and the flow after priming is smoother.

Deprimers are designed such that they cause gradual stoppage of siphonic action without producing shocks. The area of deprimers is generally kept at a minimum of 5 % of the area of the barrel. The actual area required depends on the operating head that is the intensity of negative pressure likely to be in the dome. When a siphon works, a surface fall in the reservoir water levels is created between the up and downstream of the dome. The deprimers have to be kept with their mouths at levels corresponding to this surface fall so that depriming may take place correctly at F.R.L. Regarding their shape, they are kept circular.

When siphons are placed in batteries, side by side, the distance of the centres of barrels between them should be such that no interference of flow is caused. The flow to the funnels takes place from an area below the drum. The flow in a siphon is similar to that in a “sink". The lines of flow in a field with two sinks placed side by side maybe drawn and their strength calculated. In Hirebhasgar eleven siphons of 18 feet diameter have been placed at 45 feet distance from centre to centre with no appreciable interference effects.

6. PRESSURES IN A SIPHON

The pressures in a Siphon vary with the velocities at different elevations above the invert level of the outlet. At each horizontal cross section of the barrel also there is variation in velocity. The flow is linear in the annular space. In the dome, the flow is circular being parallel to the intrados. Where the flow enters at the lip of the funnel it is radial. As it begins to hug the volutes it becomes partly circumferential and partly radial. When it drops down to the barrel, it continues to be so and forms a water seal. After the siphon has primed, the flow fills the dome and the barrel. The water shoots out of the outlet with a twist.

Observations of pressures after a siphon has primed, indicate that maximum negative pressure occurs at the throat and again the apex of the inner bend. Where the operating head exceeds about 30 feet cavitation occurs at these places. The negative pressures at the intrados of the dome increases for a short distance from the lip and then gradually falls down reaching a minimum value at the crown. In funnel, the negative pressure decreases as the water descends down reaching a maximum at the throat. In the barrel the negative pressure goes on decreasing from the throat downwards till the bend. In the bend itself the pressure is negative at the inner side, is a maximum at the apex, and is positive at the outer side. At the outlet, pressures are positive.

7. VERTICAL VELOCITY

The vertical velocity observations indicate that the velocity at the F.R.L. is very little even at points close to the periphery of the dome. The velocity goes on increasing reaching a maximum at the bottom of the drum. Below the drum, the velocity goes on decreasing. The velocity also decreases as its distance away from the drum. It is also noticed that the velocity of the flow at the bottom of the drum is uniform around its circumference irrespective of the nearness of the drum to the front face of the dam. Flow feeding a siphon comes mostly from the bottom.

The velocity of approach to a siphon in big reservoirs will be negligible as the river meets the reservoir water spread several miles upstream. The velocity at the surface is also very small. The only chance for any floating logs of wood to get in is, therefore, through the vortices only. These get formed generally in the triangular space between two neighbouring siphons and the front face of the dam. If the strength of the vortices has been weakened by increasing the depth of the drum and thus lengthening their paths, the siphons will be practically free from logs getting in. At Hirebhasgar, the vortices were two feet to three feet in diameter. A bamboo raft eight feet by eight feet and about eight inches in thickness could not be dragged inside the siphon, though it worked for six days continuously.

The section of the masonry dam need not be changed if the siphon barrel is housed away from the dam by constructing a separate masonry platform. The dome and the drum rest on pillars founded on the platform. The thrust at the bend can be designed to be taken by a thrust block forming part of the masonry platform. To minimise vibrations in the dam, it is better to have a cushion of some damping material around the outlet pipe and also to separate the masonry platform from the dam by a butt joint.

8. REAR PROTECTIVE WORKS

The nature of the protective works to be given in rear of the siphons depends naturally on various factors such as tail water level, nature of river bed, etc,, present downstream. The discharge from a siphon is always a throw off to a fixed distance away from the dam, as the velocity is due to a practically unchanging operating head. No fear of retrogression needs be apprehended as in the case of varying discharges from a sluice. A cut off wall in rear of the point of throw off on the river bed is all that may be required in most cases.

9. USE AS PRIMING SIPHONS

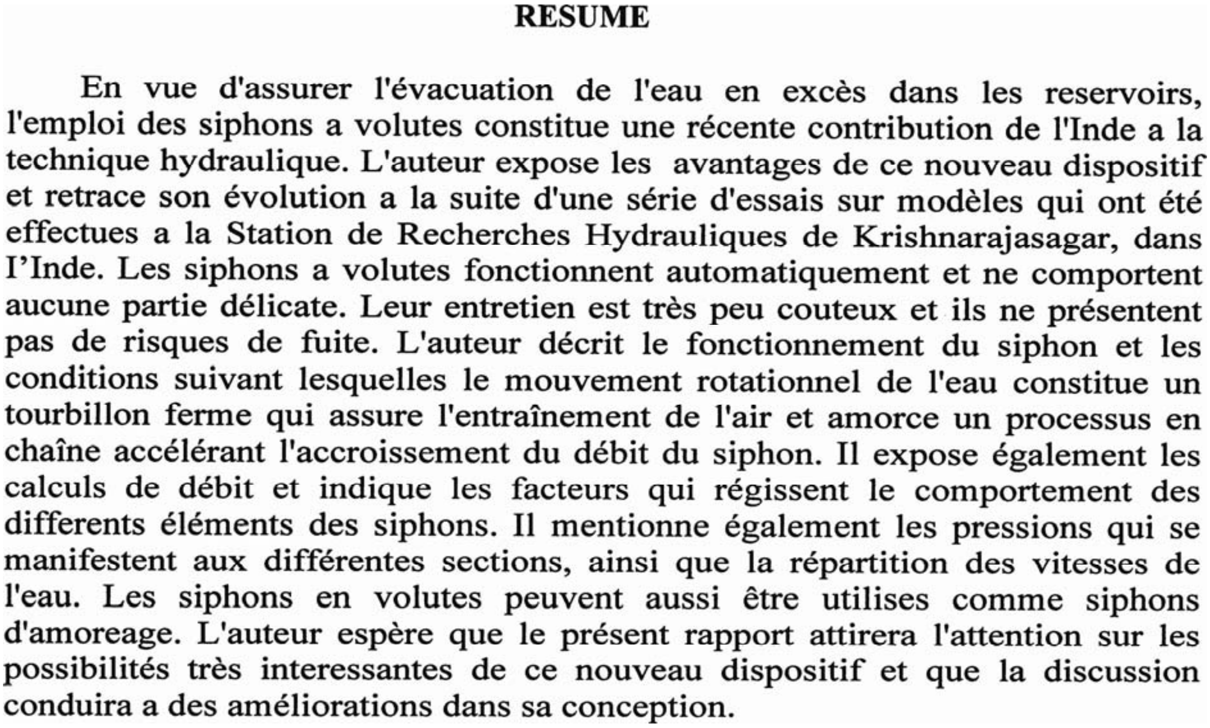
The volute siphons have also been successfully used as *priming siphons* to a battery of saddle siphons to reduce their priming depth. A saddle siphon which takes twelve inches to prime can be made to prime for less than two inches by connecting a volute siphon to it. The area of the priming siphons is generally kept at about 5 % of the area of the main siphons.

10. CONCLUSION

The use of volute siphons as surplussing works on dams is a recent innovation in the field of Hydraulics. Such volutes have actually been constructed at Marconhalli and Hirabhasgar Dams in Mysore and are functioning satisfactorily. These siphons are automatic in action, require very little maintenance and are gaining preference over other types for their efficient performance. The design of such siphon is, however, still in an early stage and model experiments have been and are being carried out at different irrigation research stations in India to effect improvements and to perfect the design. The main object of the author in putting up this paper is to bring to the notice of the profession the advantages of this new device and to evoke useful discussions which may popularise its use and lead to further improvements in its design.

SUMMARY

The use of Volute Siphons to pass surplus from reservoirs is a recent contribution from India to the science of Hydraulic Engineering. The paper describes the advantages of this new device and its evolution and development through a series of model experiments at the Hydraulic Research Station Krishnarajasagar Mysore, India. The Volute Siphons are automatic in action and have no delicate parts. They have very little maintenance cost and are leak proof. The paper describes the working of the siphon and the manner in which rotating water forms a seal to screw out air. The calculations for computing the discharge and the factors governing the various component parts of the siphons are also described. Mention has also been made of the pressures at various sections of the siphon and the distribution of velocities in and around a siphon. The volute siphons can also be used as priming siphons where saddle or other types have been installed. It is considered that this paper would bring to the notice of the profession the potentialities of this new device and the discussions may lead to improvement in the design of the siphons.



RESUME

En vue d'assurer l'évacuation de l'eau en excès dans les reservoirs, l'emploi des siphons a volutes constitue une récente contribution de l'Inde a la technique hydraulique. L'auteur expose les avantages de ce nouveau dispositif et retrace son évolution a la suite d'une série d'essais sur modèles qui ont été effectues a la Station de Recherches Hydrauliques de Krishnarajasagar, dans I’Inde. Les siphons a volutes fonctionnent automatiquement et ne comportent aucune partie délicate. Leur entretien est très peu couteux et ils ne présentent pas de risques de fuite. L'auteur décrit le fonctionnement du siphon et les conditions suivant lesquelles le mouvement rotationnel de l'eau constitue un tourbillon ferme qui assure l'entraînement de l'air et amorce un processus en chaîne accélérant l'accroissement du débit du siphon. Il expose également les calculs de débit et indique les facteurs qui régissent le comportement des differents éléments des siphons. Il mentionne également les pressions qui se manifestent aux différentes sections, ainsi que la répartition des vitesses de l'eau. Les siphons en volutes peuvent aussi être utilises comme siphons d'amoreage. L'auteur espère que le présent rapport attirera l'attention sur les possibilités très interessantes de ce nouveau dispositif et que la discussion conduira a des améliorations dans sa conception.