ALLOW FOR "OVERLAP" Of one displacement to the next. This is dependent on the volumetric efficiency, due to compressibility of your system liquid.

This may radically effect the level of flow fluctuation, and pressure pulsation.

1. Input data:

VE := 77.512 % Actual displacement divided by 100% Volumetric Displacement

L := 450 mm Connection rod length

R := 60 mm Crankshaft radius

2. Calculations

$VI := \frac{100 - VE}{100}$ VI = 0.225 Volumetric Inefficiency*

X := VI x 2 x R X = 26.986 Stroke before valve opening

$\psi := 1.5$ Parameter for calculation purposes

$$\phi := \text{root}\left[X - \sqrt{L^2 - (R \times \sin(\psi))^2} + L - R \times (1 - \cos(\psi)), \psi\right]$$

Angle := 57.3 x ϕ Phase delay, degree 59.9999° say 60°

If in this example, left, the pump was a triplex then the flow would come to a complete halt between strokes. This is because a rotary driven reciprocating pump sucks & discharges for 180⁰ of rotation and the next displacement begins after 120⁰. The overlap on triplex at 100% efficiency is therefore 60⁰. At 77.512 % the calculation shows that the 60⁰ has been lost, hence with no overlap the flow will come to a halt between displacements. It will be as "pulsatious" as a duplex.

By the same calculation as the example; if the efficiency was 85% then the lost angle would become 48⁰. With a "Quin" a new displacement should begin every 72 degrees (360/5), and as discussed above a triplex should displace every 120⁰. 120⁰ minus 72⁰=48⁰. But at 85% efficiency, 48 has been lost, so a Quin can cause as much flow fluctuation as a perfect Triplex if the quin has low volumetric efficiency.

∴ ***A three headed diaphragm metering pump may produce flow fluctuations as bad as,or worse than, a duplex pump or double acting simplex pump. A quintuplex, or 5 plunger pump, may produce flow fluctuations as good as, or worse than,a good triplex pump, it all depends on volumetric efficiency.***

Consequently, on page where N² is a divisor, you would have to treat a triplex N² as 2x2 =4 , not 3x3=9.

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