Wave winding example

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Problem statement

Develop a winding diagram for a 4 pole dc generator, with armature having 11 slots. The winding is double layer, progressive, simplex WAVE winding.

Explanation

1. Due to double layer winding, 11 slots will accomodate 22 conductors.
2. 11 (slots) is not completely divisible by 4 (number of poles). So One pole will cover 2 slots. Other three poles will cover 3 slots each.

Winding development

1. Using the formula to find winding pitch, back pitch and front pitch

$$Y_w\ (winding\ pitch) = \frac{2C \pm 2}{2P} \quad (1)$$

$$Y_b + Y_f = Y_w \quad (2)$$

$$(3)$$

2. Y_b and Y_f are found out to be 12 or 10.
3. Y_p is the pole pitch and is 5.5
4. $Y_b = 7\ and\ Y_f = 5$ is one solution.
5. $Y_b = Y_f = 5$ is the other solution.

Yb=Yf=5

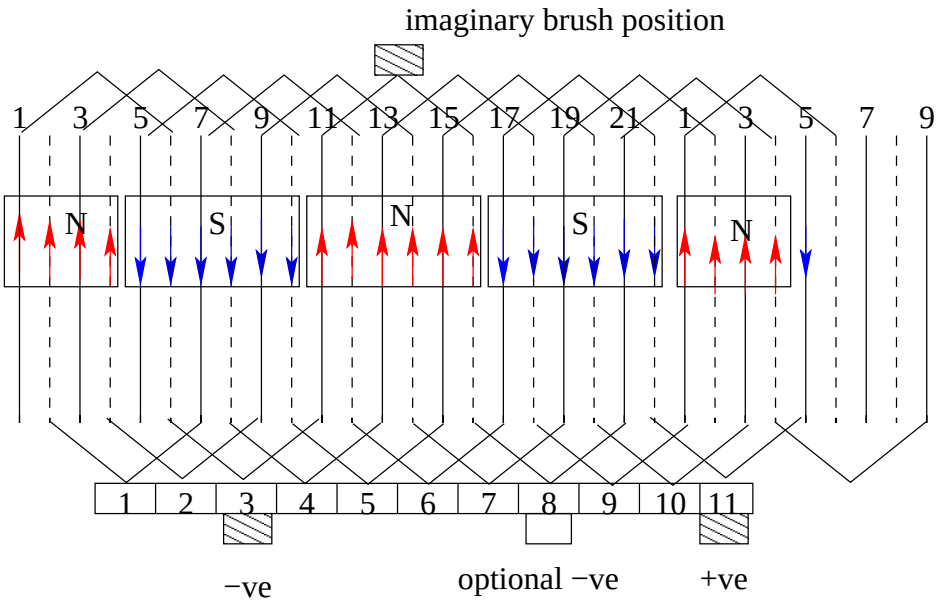

Figure 1: Wave winding diagram

Show the current directions

Using the *explanation* section above, we show the poles and slots under them on the graphpaper. Each slot has two conductors inserted in it. In our case, we show currents under the N poles going into the generator and currents are coming out in the conductors under the S poles. See the figure 1.

Connection sequence 1

Using $Y_b = 7, Y_f = 5$
$1 \uparrow 8 \downarrow 13 \uparrow 20 \downarrow 3 \uparrow 10 \downarrow 15 \uparrow 22 \downarrow 5 \uparrow 12 \downarrow 17 \uparrow 2 \downarrow 7 \uparrow 14 \downarrow 19 \uparrow 4 \downarrow 9 \uparrow 16 \downarrow 21 \uparrow 6 \downarrow 11 \uparrow 18 \downarrow 1.$ is the connection sequence.
Now using the current direction we search for +ve and -ve brush positions. We get +ve brush postion at commutator segment 11. But -ve position is neither availabe at front nor at the back. So we reject these pitches and the connection sequence.

Connection sequence 2

Using $Y_b = 5, Y_f = 5$
$1 \uparrow 6 \downarrow 11 \uparrow 16 \downarrow 21 \uparrow 4 \downarrow 9 \uparrow 14 \downarrow 19 \uparrow 2 \downarrow 7 \uparrow 12 \downarrow 17 \uparrow 22 \downarrow 5 \uparrow 10 \downarrow 15 \uparrow$

$20 \downarrow 3 \uparrow 8 \downarrow 13 \uparrow 18 \downarrow 1$ is the connection sequence.
Here we find the +ve brush position at segment 11. At the back node where the current directions go inside the generator, is the imaginary position of the -ve brush. But there is no commutator to rest upon. So corrosponding segment (3 or 8) can be used for placing -ve brush. **So we accept this connection sequence and develop the winding accordingly.** See the figure 1 on page 2

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