

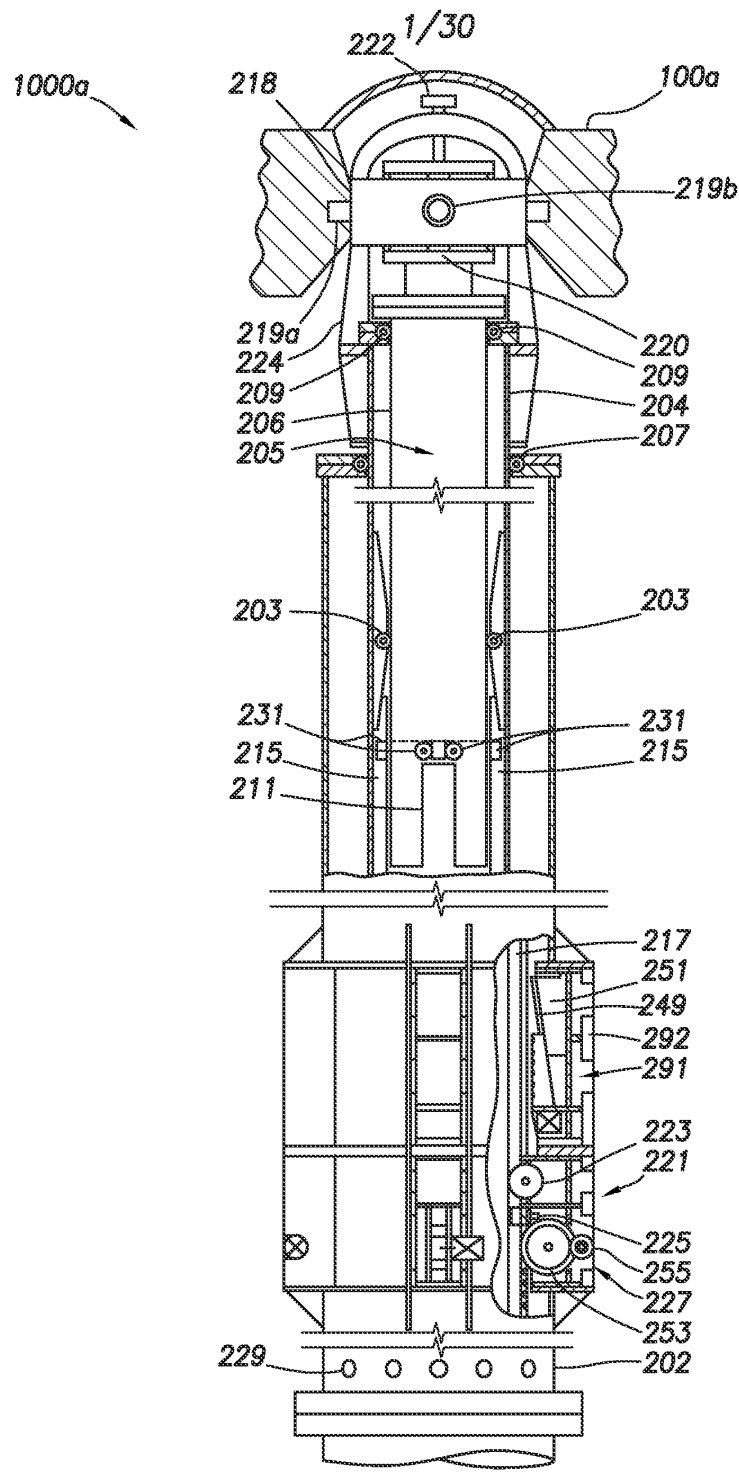
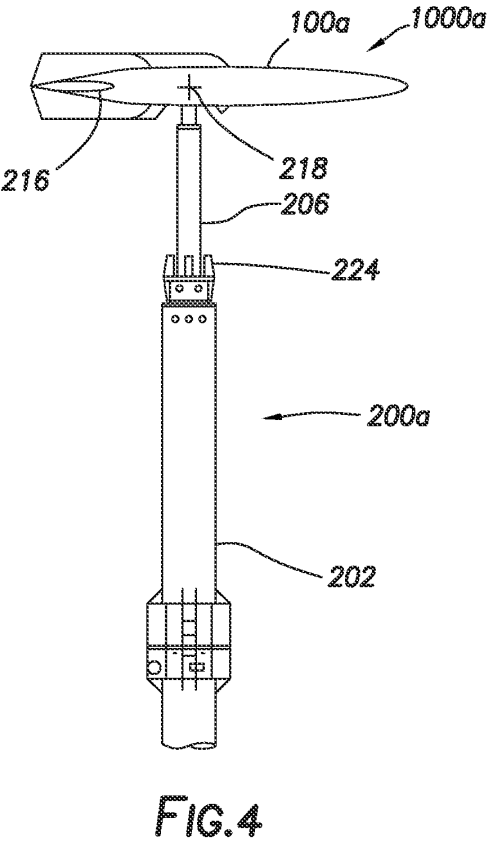
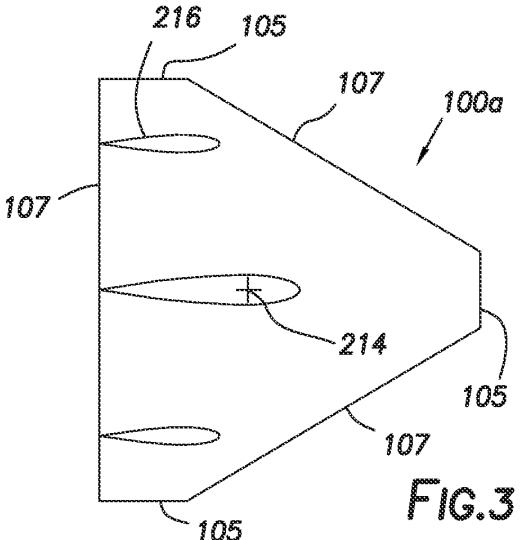
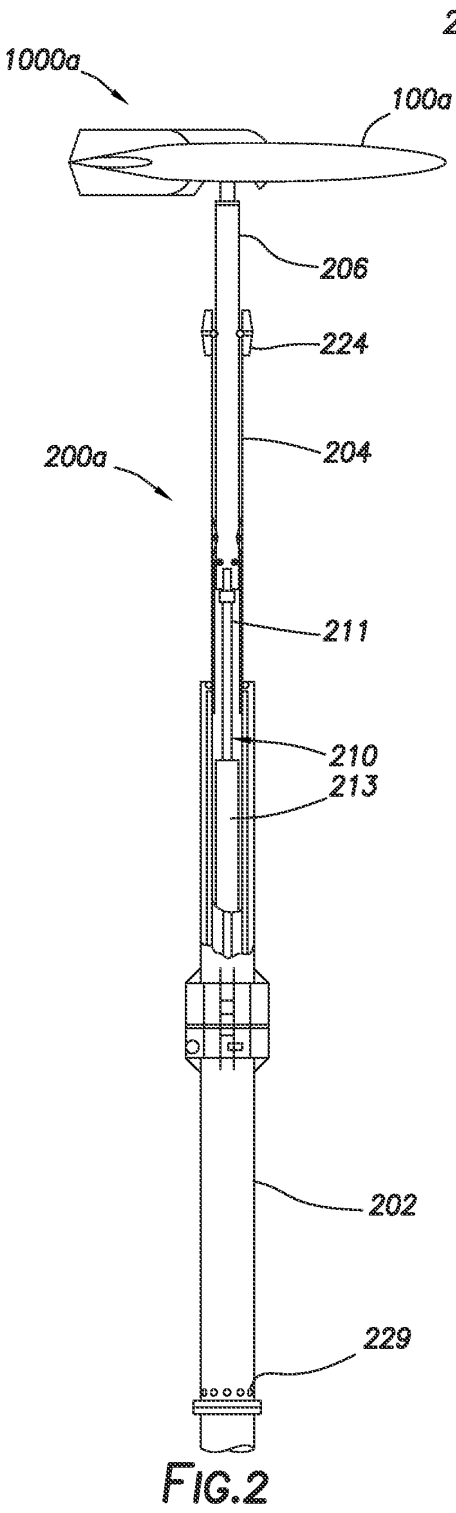
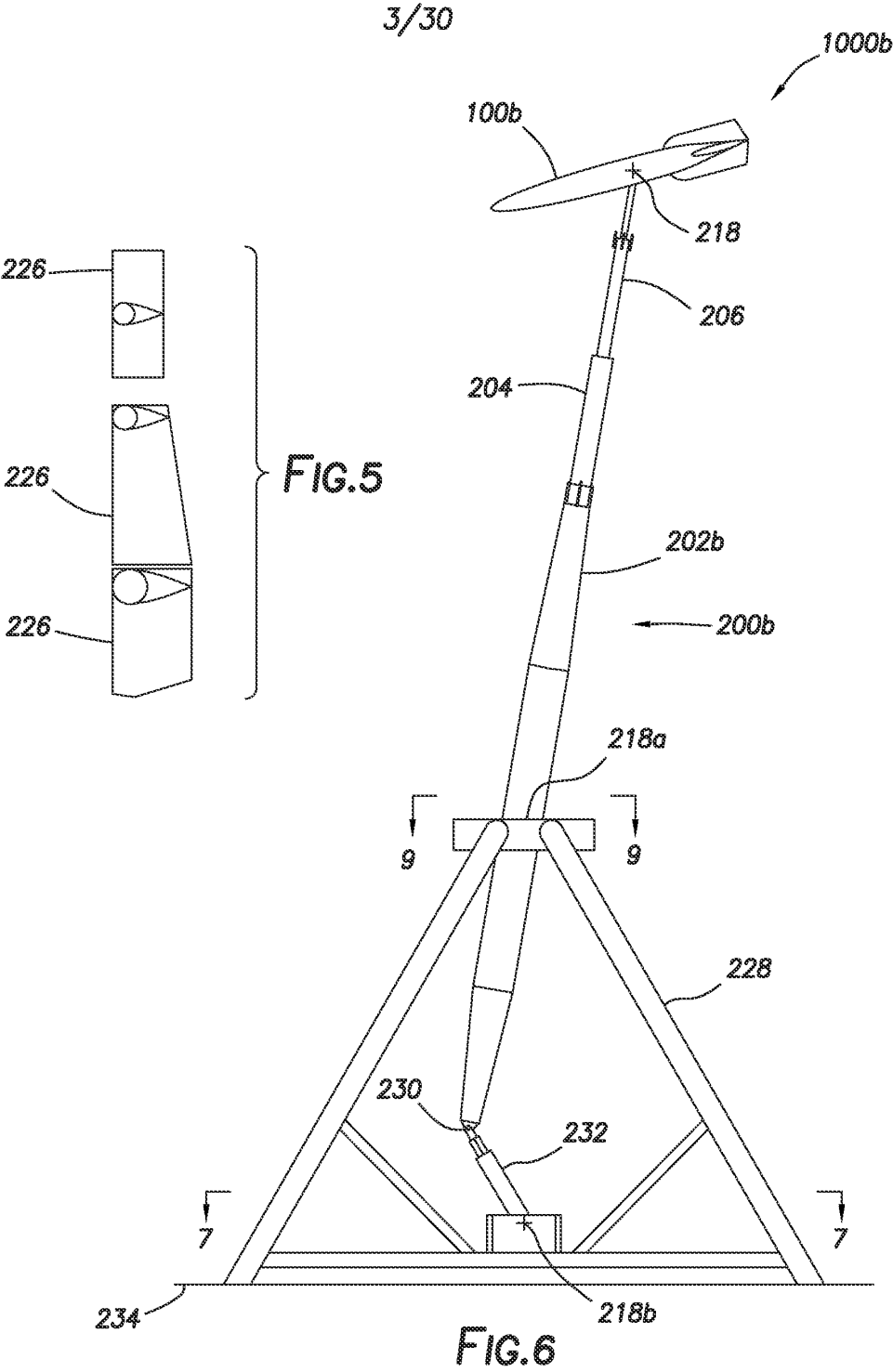


FIG.1

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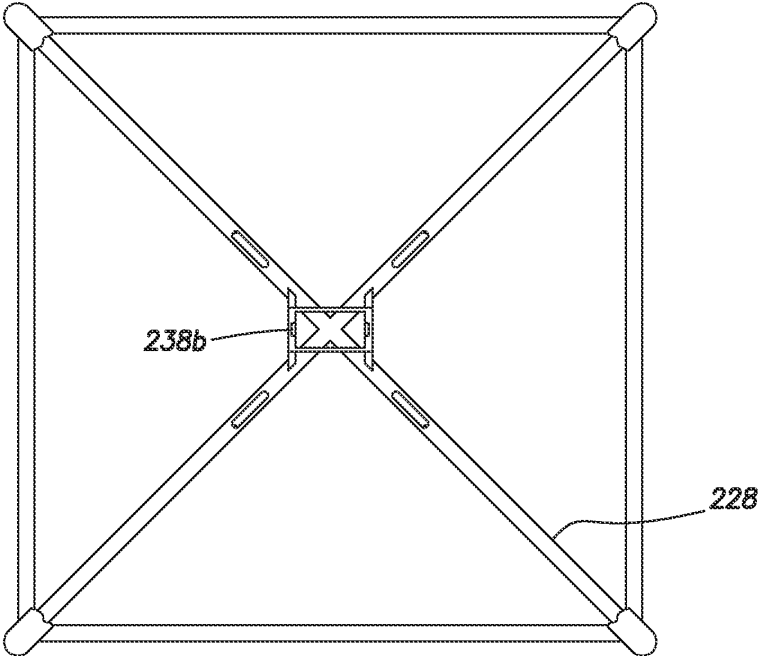


FIG. 7

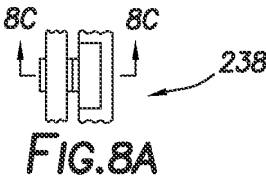


FIG. 8A

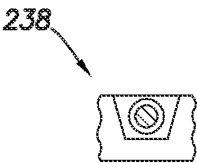


FIG. 8B

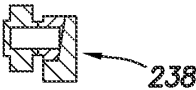


FIG. 8C

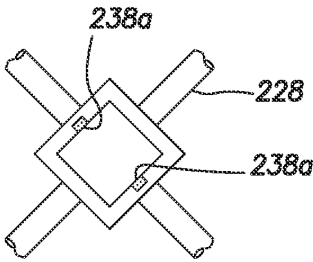


FIG. 9

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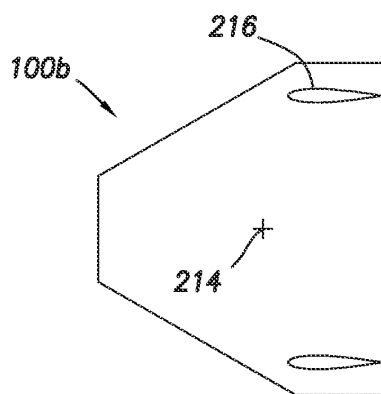


FIG. 10

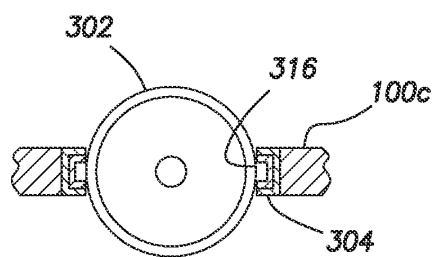


FIG. 11

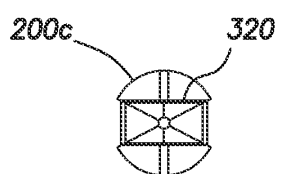


FIG. 12

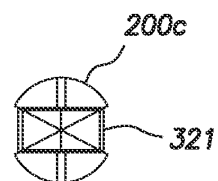


FIG. 13

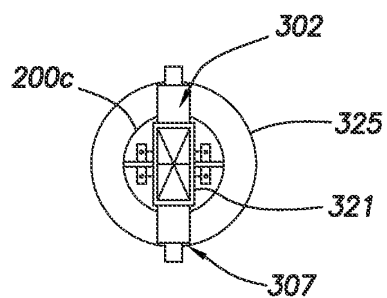
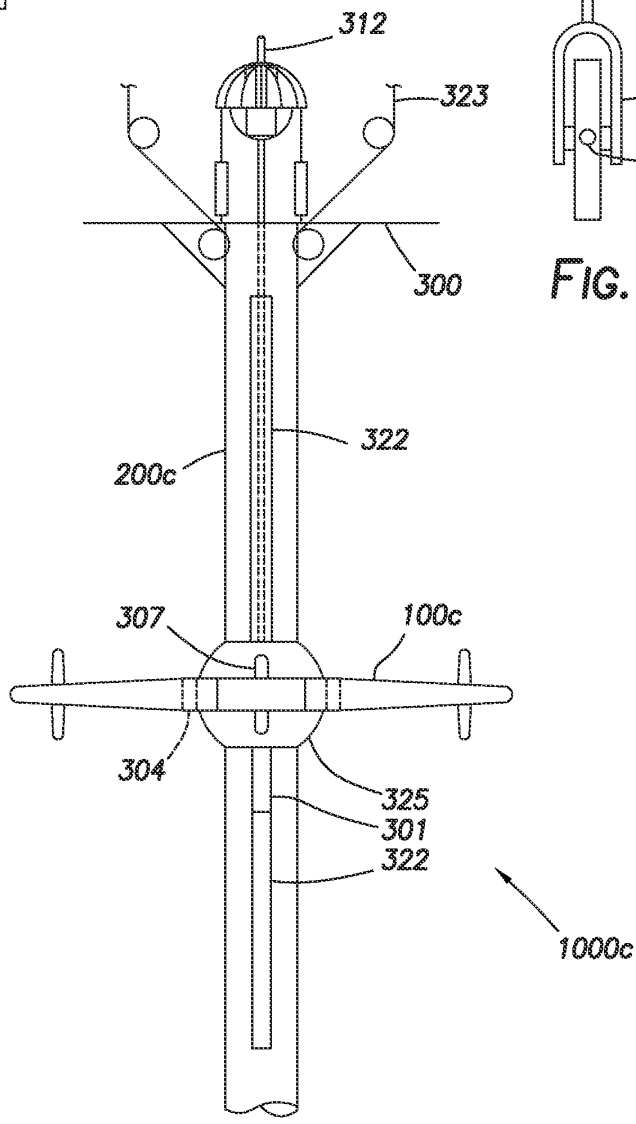
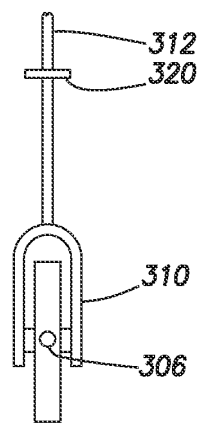
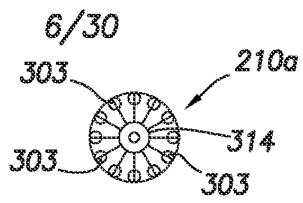
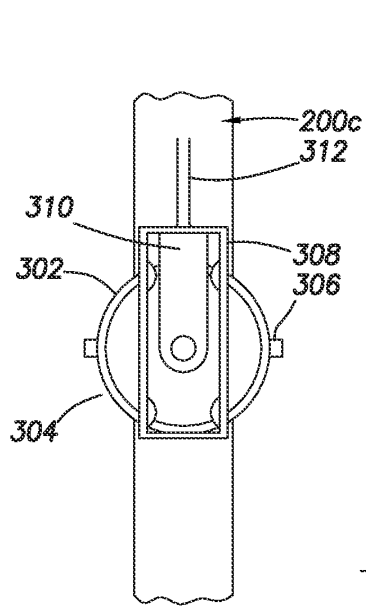
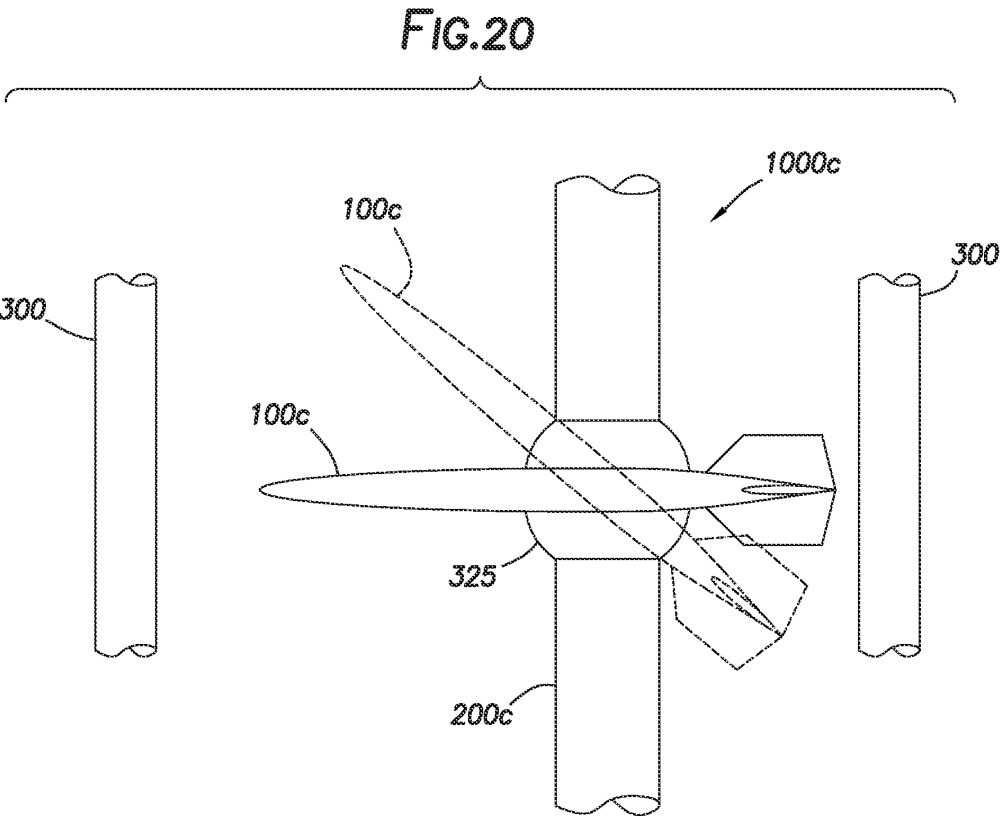
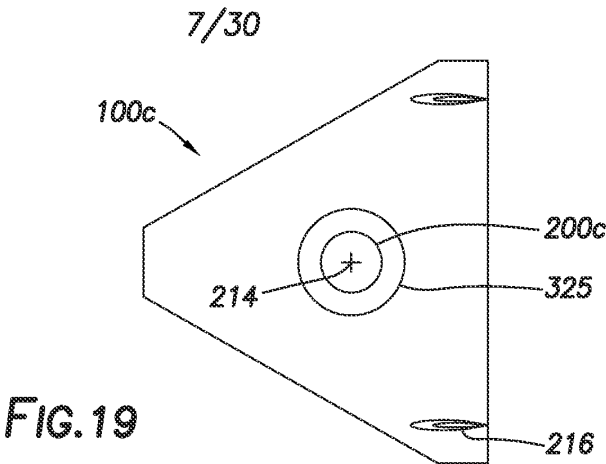


FIG. 14





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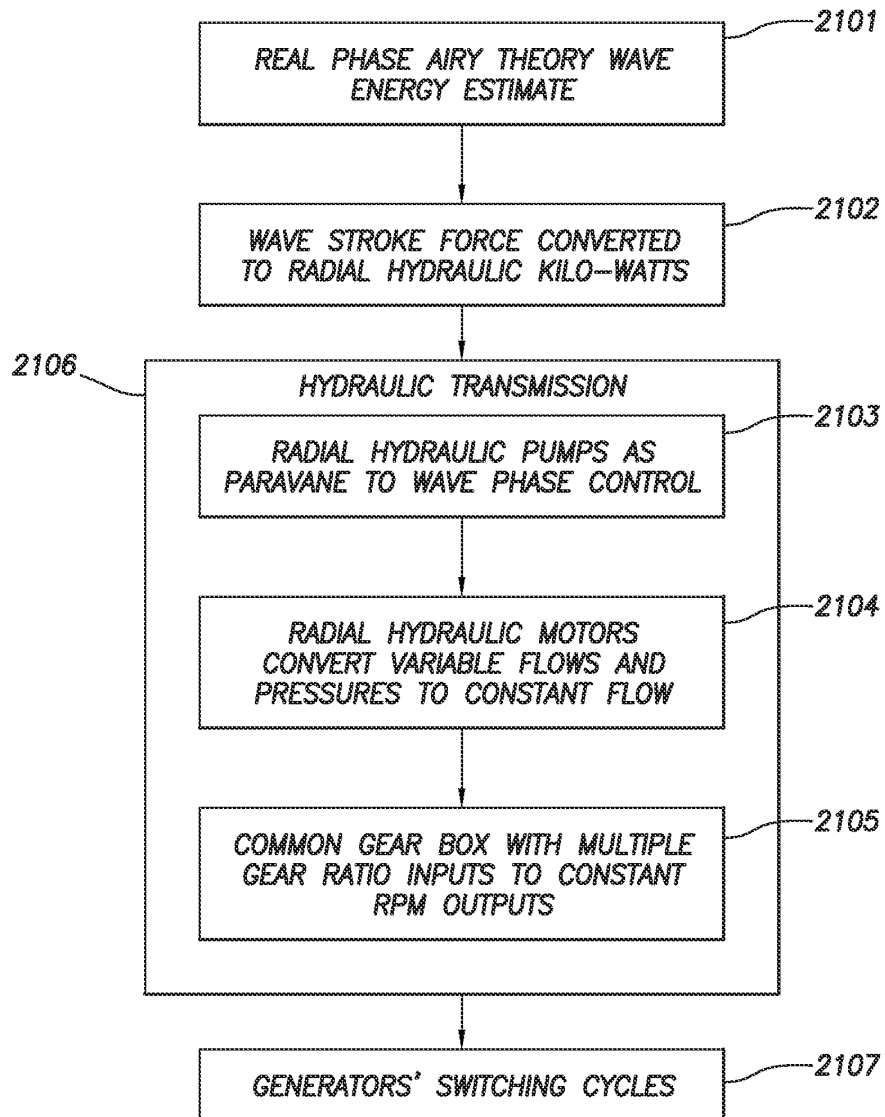


FIG.21

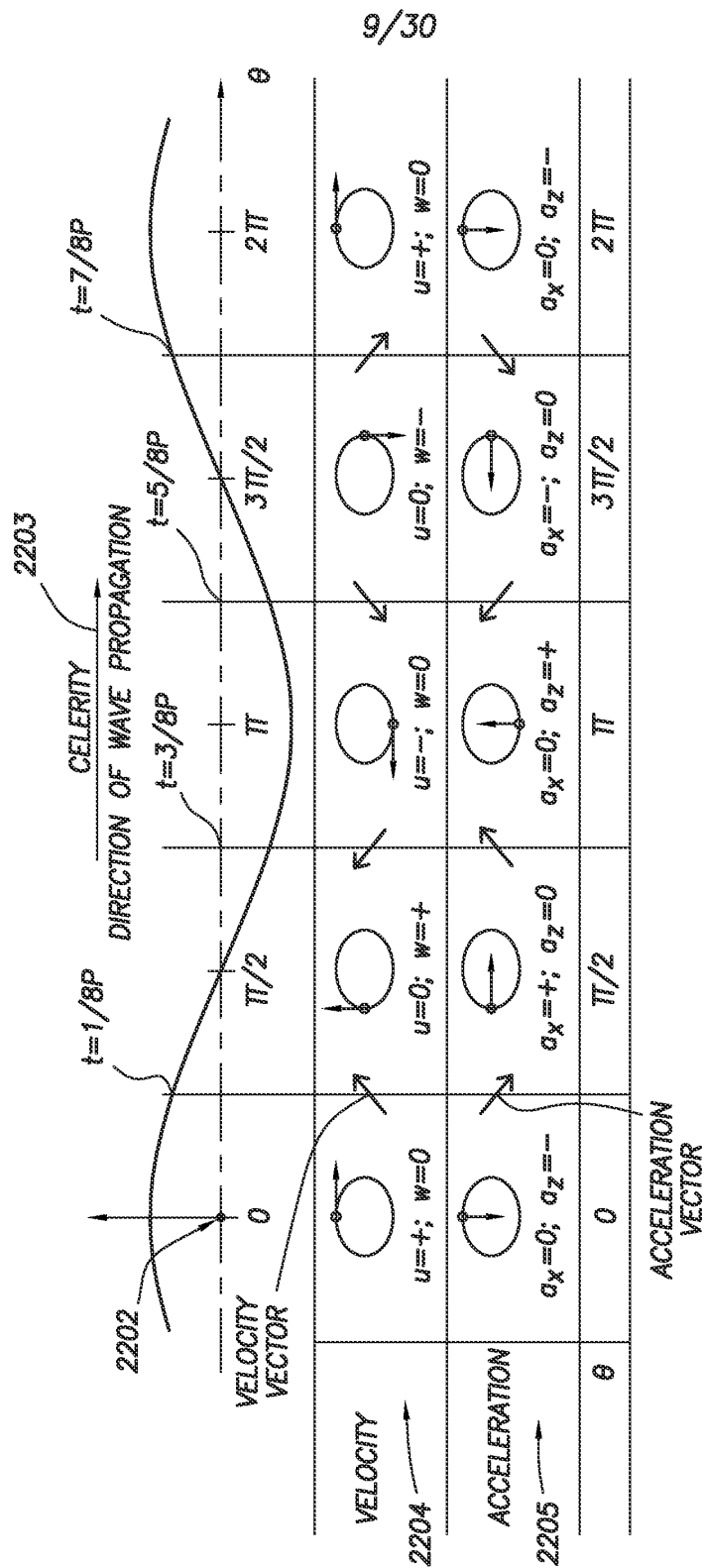


FIG.22A

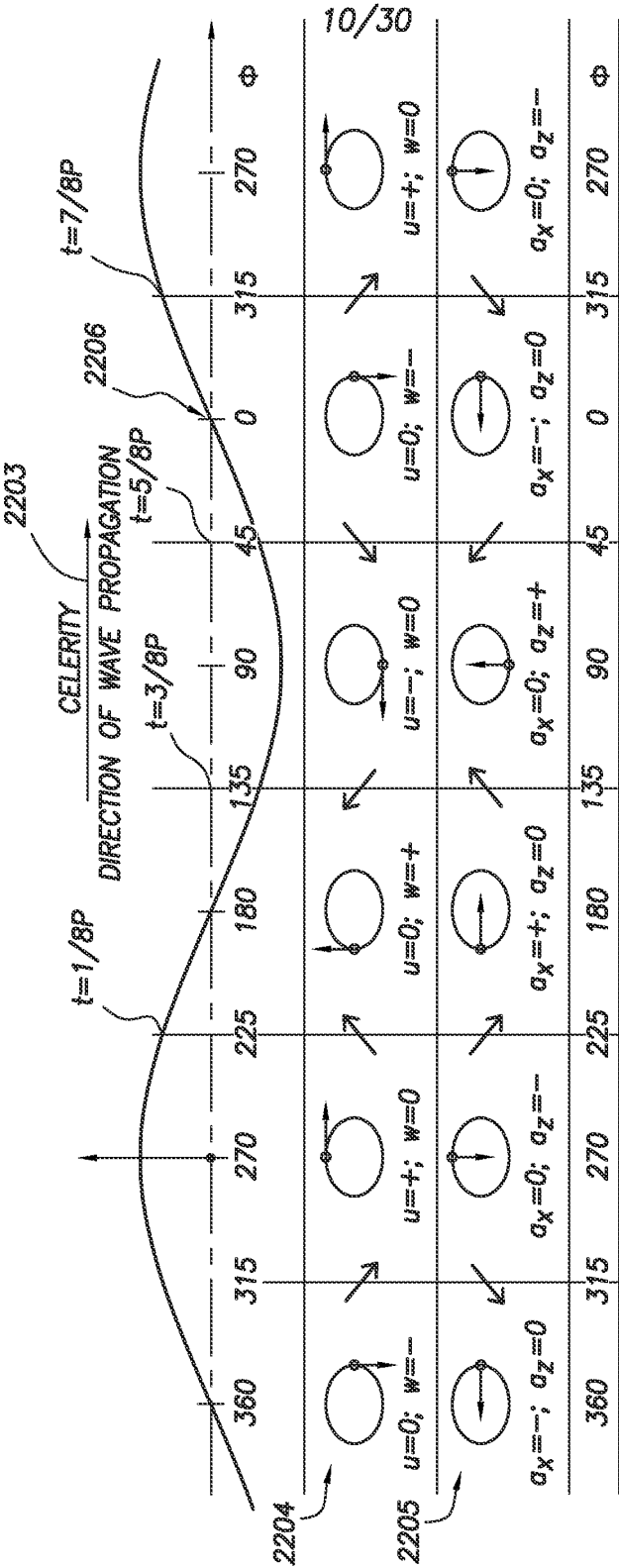


FIG.22B

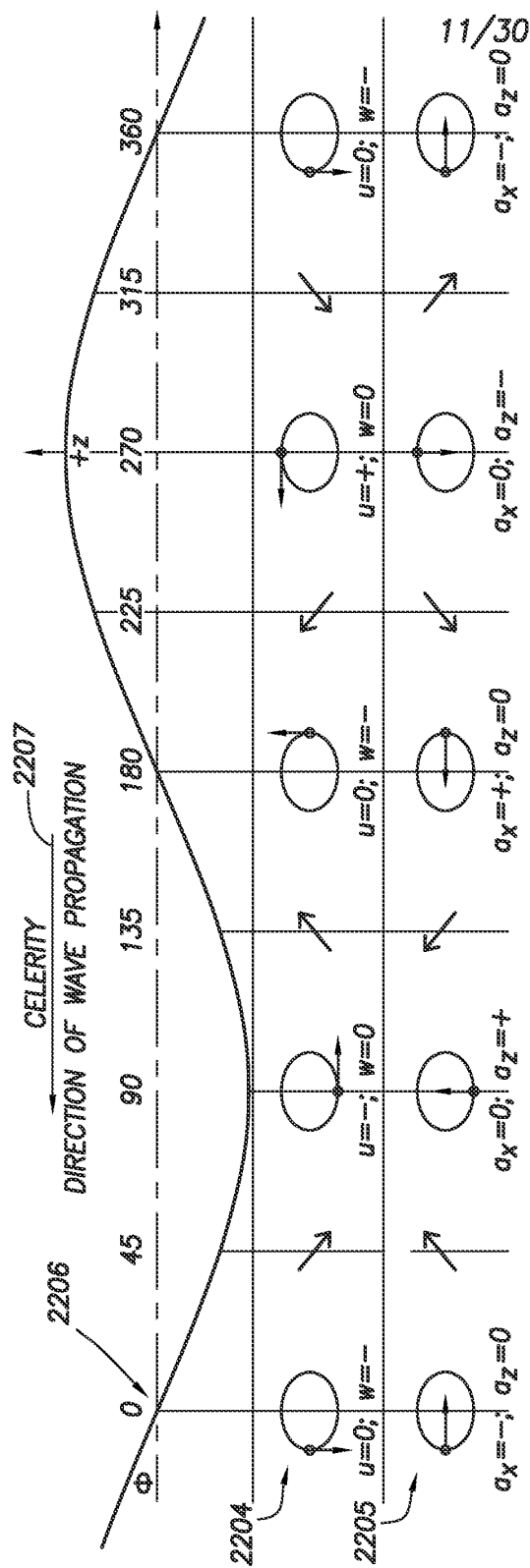


FIG.22C

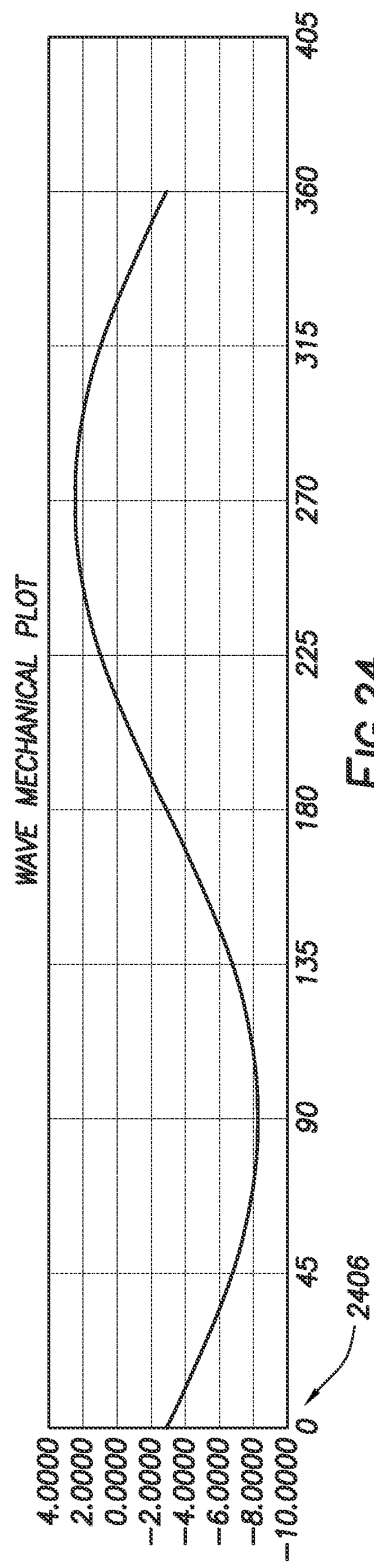


FIG.24

GIMBALLED PARAVANE HEAVE VECTORS: NORMAL AND STROKE $\odot$ PHASES $\Phi 0^{\circ}-89^{\circ}$
PARAVANE PITCH / ROLL ANGLE (DEGREES, +CW/-CCW) = $P.R.\Phi$

HEAVE VELOCITY ($w.V$) $\odot \Phi = w.V.\Phi$

$\cos \theta = \text{adj}/\text{hyp}$

$\cos \theta * \text{hyp} = \text{adj}$

$\cos((w.\theta.\Phi - (180 - \text{ABS}(P.R.\Phi))) * w.\Phi = w.V.\Phi$

$* \cos(\text{ABS}(P.R.\Phi)) = w.V.\Phi$

HEAVE ACCELERATION ($a.A$) $\odot \Phi = a.A.\Phi$

$\cos \theta = \text{adj}/\text{hyp}$

$\cos \theta * \text{hyp} = \text{adj}$

$\cos(((360 - \text{ABS}(P.R.\Phi)) - A.z.\theta.\Phi)) * a.z.\Phi = a.Z.\Phi$

$* \cos(\text{ABS}(P.R.\Phi)) * a.Z.\Phi = a.A.\Phi$

$w.V.\Phi = \cos(\text{ABS}(P.R.\Phi)) * \cos((w.\theta.\Phi - (180 - \text{ABS}(P.R.\Phi))) * w.\Phi - (180 - \text{ABS}(P.R.\Phi))) * \cos(((360 - \text{ABS}(P.R.\Phi)) - A.z.\theta.\Phi)) * a.z.\Phi$

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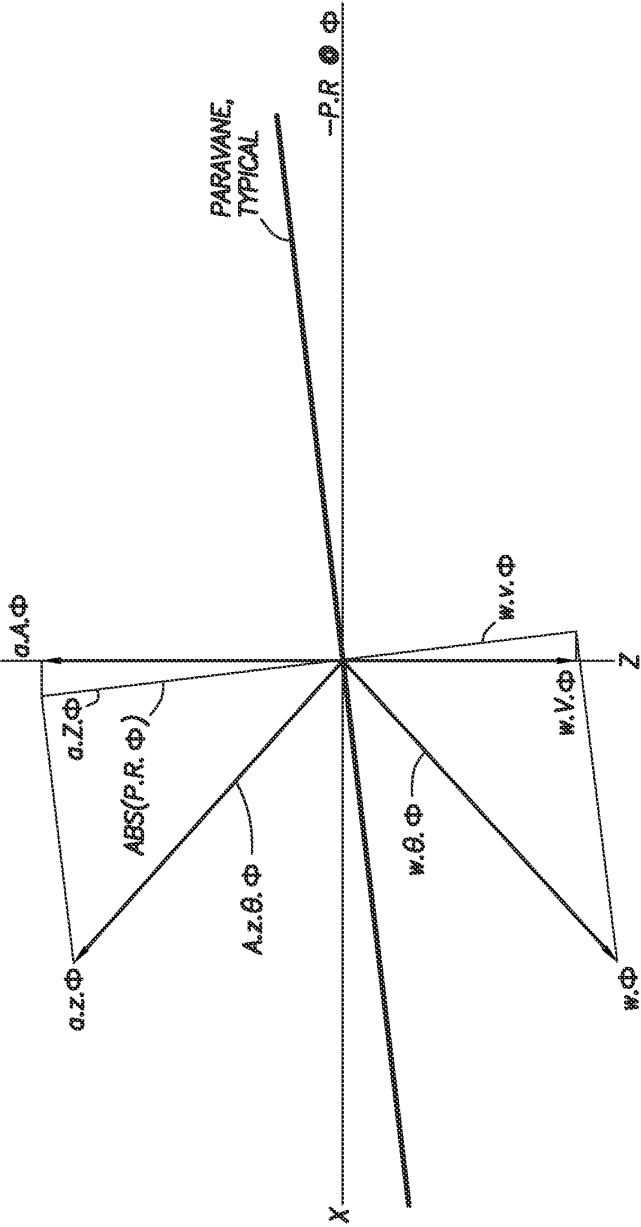


FIG.23A

GIMBALLED PARAVENE HEAVE VECTORS: NORMAL AND STROKE @ PHASES $\Phi 90^{\circ}-179^{\circ}$ PARAVENE PITCH / ROLL ANGLE (DEGREES, +CW/-CCW) = P.R. Φ	
HEAVE VELOCITY (w.V) @ $\Phi=w.V.\Phi$	HEAVE ACCELERATION (a.A) @ $\Phi=a.A.\Phi$
$\cos \theta =adj/hyp$	$\cos \theta =adj/hyp$
$\cos \theta *hyp=adj$	$\cos \theta *hyp=adj$
$\sin((W.\theta.\Phi-(270+ABS(P.R.\Phi))))*w.V.\Phi$	$\cos(A.z.\theta.\Phi-(ABS(P.R.\Phi)))^)*a.z.\Phi=a.z.\Phi$
$*cos(ABS(P.R.\Phi)^*)=w.V.\Phi$	$*cos(ABS(P.R.\Phi)^*)=a.A.\Phi$
$w.V.\Phi = -cos(ABS(P.R.\Phi)^*)*sin((W.\theta.\Phi-(270+ABS(P.R.\Phi))))^)*w.V.\Phi$	$a.A.\Phi = -cos(ABS(P.R.\Phi)^*)*cos(A.z.\theta.\Phi-(ABS(P.R.\Phi)))^)*a.z.\Phi$

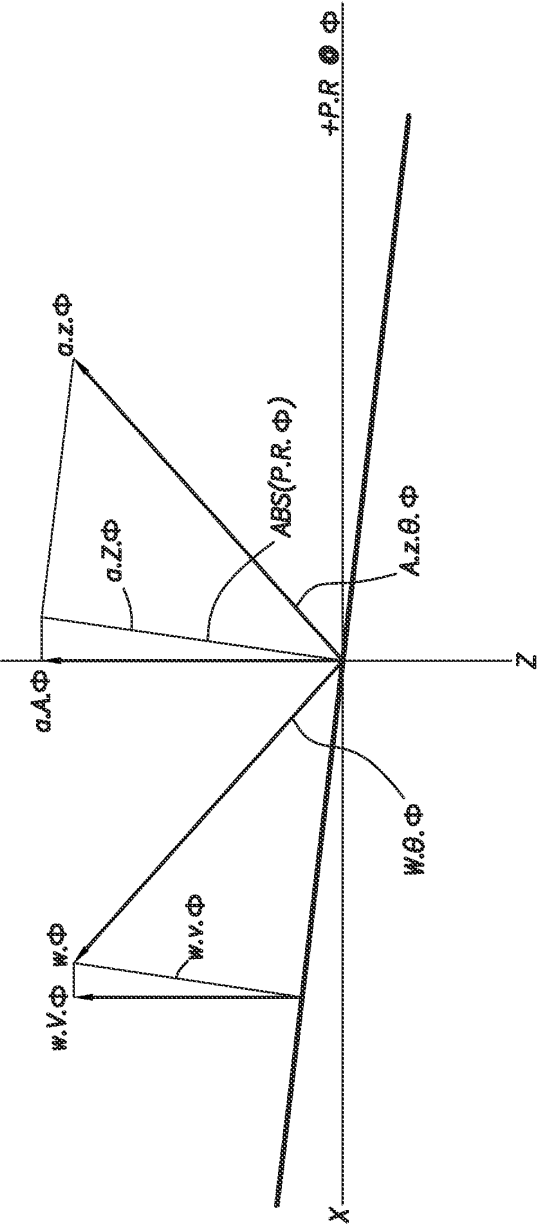


FIG.23B

GIMBALLED PARAVENE HEAVE VECTORS: NORMAL AND STROKE $\odot$ PHASES Φ $180^{\circ}-269^{\circ}$
PARAVENE PITCH / ROLL ANGLE (DEGREES, +CW/-CCW) = $P.R.\Phi$

HEAVE VELOCITY ($w.V$) $\odot \Phi = w.V.\Phi$
 $\cos \theta = \text{adj}/\text{hyp}$
 $\cos \theta * \text{hyp} = \text{adj}$
 $\cos((w.\theta.\Phi - (\text{ABS}(P.R.\Phi))^{\circ}) * w.\Phi = w.V.\Phi$
 $* \cos(\text{ABS}(P.R.\Phi)^{\circ}) = w.V.\Phi$

HEAVE ACCELERATION ($a.A$) $\odot \Phi = a.A.\Phi$
 $\cos \theta = \text{adj}/\text{hyp}$
 $\cos \theta * \text{hyp} = \text{adj}$
 $\cos(((180 + \text{ABS}(P.R.\Phi))^{\circ}) - A.z.\theta.\Phi)^{\circ}) * a.z.\Phi = a.Z.\Phi$
 $* \cos(\text{ABS}(P.R.\Phi)^{\circ}) = a.A.\Phi$

$w.V.\Phi = -\cos(\text{ABS}(P.R.\Phi)^{\circ}) * \cos((w.\theta.\Phi - (\text{ABS}(P.R.\Phi))^{\circ}) * w.\Phi$
 $a.A.\Phi = -\cos(\text{ABS}(P.R.\Phi)^{\circ}) * \cos(((180 + \text{ABS}(P.R.\Phi))^{\circ}) - A.z.\theta.\Phi)^{\circ}) * a.z.\Phi$

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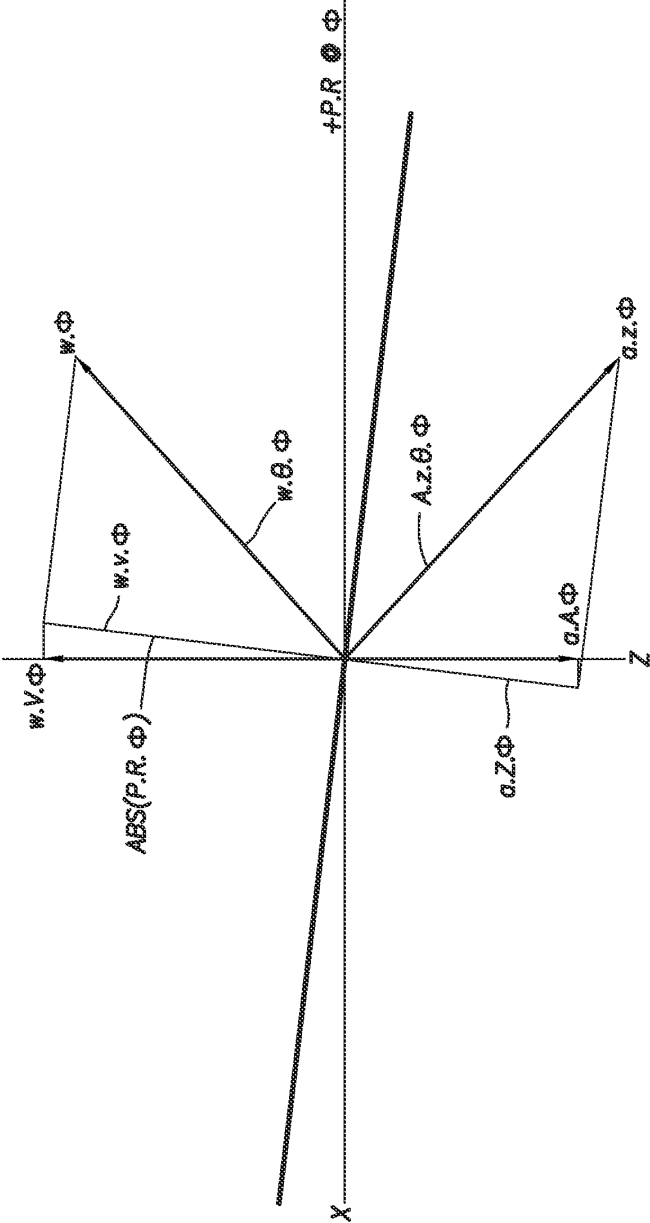


FIG.23C

GIMBALLED PARAVENE HEAVE VECTORS: NORMAL AND STROKE Φ PHASES $\Phi 270^{\circ}-359^{\circ}$
PARAVENE PITCH / ROLL ANGLE (DEGREES, +CW/-CCW) = $P.R.\Phi$

HEAVE VELOCITY ($w.V$) $\Phi = w.V.\Phi$

$\cos \theta = \text{adj}/\text{hyp}$

$\cos \theta * \text{hyp} = \text{adj}$

$\cos(((180 - \text{ABS}(P.R.\Phi)) - W.\theta.\Phi)) * w.V.\Phi = w.V.\Phi$

$* \cos(\text{ABS}(P.R.\Phi)) = w.V.\Phi$

HEAVE ACCELERATION ($a.A$) $\Phi = a.A.\Phi$

$\cos \theta = \text{adj}/\text{hyp}$

$\cos \theta * \text{hyp} = \text{adj}$

$\sin((270 - \text{ABS}(P.R.\Phi)) - A.z.\theta.\Phi) * a.z.\Phi = a.z.\Phi$

$* \cos(\text{ABS}(P.R.\Phi)) = a.A.\Phi$

$w.V.\Phi = -\cos(\text{ABS}(P.R.\Phi)) * \cos(((180 - \text{ABS}(P.R.\Phi)) - W.\theta.\Phi)) * w.V.\Phi$	$a.A.\Phi = -\cos(\text{ABS}(P.R.\Phi)) * \sin((270 - \text{ABS}(P.R.\Phi)) - A.z.\theta.\Phi) * a.z.\Phi$
--	--

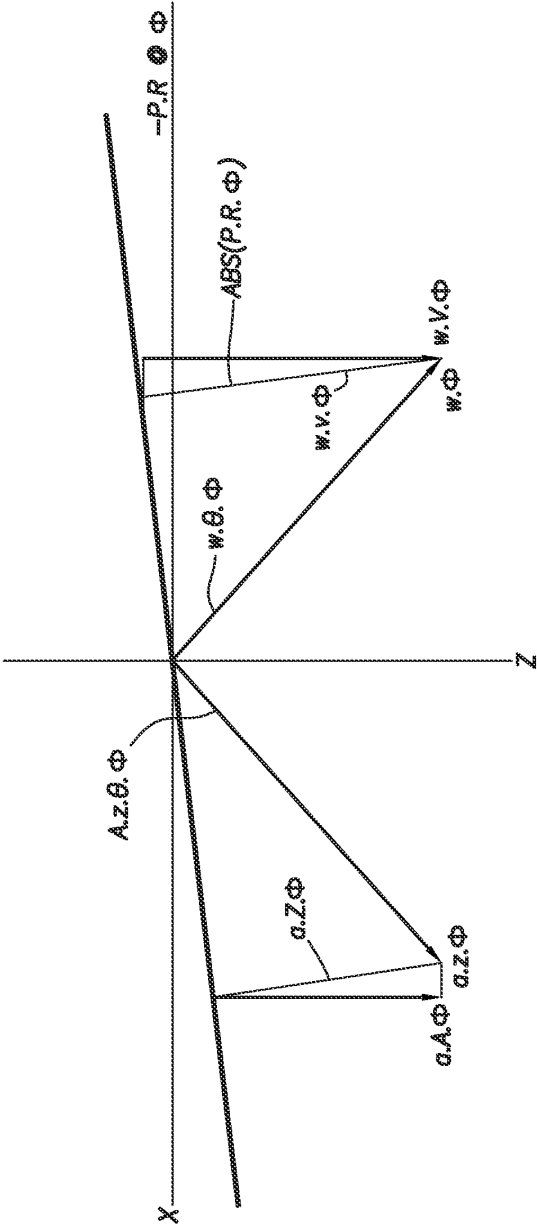


FIG.23D

GIMBALLED PARAVANE SURGE AS HEAVE VECTORS: NORMAL AND STROKE $\odot$ PHASES Φ 0° - 89°
PARAVANE PITCH / ROLL ANGLE (DEGREES, +CW/-CCW) = $P.R.\Phi$

SURGE AS HEAVE VELOCITY $(u.V)\odot\Phi=u.V.\Phi$

$\cos\theta = \text{adj}/\text{hyp}$
 $\cos\theta * \text{hyp} = \text{adj}$
 $\cos((U.\theta.\Phi - (180 - \text{ABS}(P.R.\Phi))) * u.\Phi = u.V.\Phi$
 $* \cos(\text{ABS}(P.R.\Phi)) = u.\text{SaH.V.}\Phi$

SURGE AS HEAVE ACCELERATION $(a.x.A)\odot\Phi = a.x.A.\Phi$

$\cos\theta = \text{adj}/\text{hyp}$
 $\cos\theta * \text{hyp} = \text{adj}$
 $\cos((U.\theta.\Phi - (180 - \text{ABS}(P.R.\Phi))) * a.\Phi = a.X.\Phi$
 $* \cos(\text{ABS}(P.R.\Phi)) = a.x.\text{SaH.A.}\Phi$

$u.\text{SaH.V.}\Phi =$ $\cos(\text{ABS}(P.R.\Phi)) * \cos((U.\theta.\Phi - (180 - \text{ABS}(P.R.\Phi))) * u.\Phi$	$a.x.\text{SaH.A.}\Phi =$ $-\cos(\text{ABS}(P.R.\Phi)) * \cos(((360 - \text{ABS}(P.R.\Phi)) - A.x.\theta.\Phi)) * a.x.\Phi$
--	--

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The diagram illustrates the vector decomposition of surge motion. A horizontal axis is labeled 'X' at both ends. Several vectors originate from a central point. One vector is labeled $u.V$ and another $a.X$. Their projections onto the horizontal axis are labeled $u.\text{SaH.V.}\Phi$ and $a.x.\text{SaH.A.}\Phi$ respectively. Other vectors and angles are labeled: $u.\theta.\Phi$, $A.x.\theta.\Phi$, $\text{ABS}(P.R.\Phi)$, and $a.X.\Phi$. A line is labeled 'PARAVANE, TYPICAL' and another vector is labeled $-P.R.\odot\Phi$.

FIG.23E

GIMBALLED PARAVENE SURGE AS HEAVE VECTORS: NORMAL AND STROKE @ PHASES Φ 90°-179°
PARAVENE PITCH / ROLL ANGLE (DEGREES, +CW/-CCW) = P.R. Φ
SURGE AS HEAVE VELOCITY (u.v) @ Φ =u.v. Φ
SURGE AS HEAVE ACCELERATION (a.x.a) @ Φ =a.x.a. Φ

$$\begin{aligned} \cos \theta &= \text{adj}/\text{hyp} & \cos \theta &= \text{adj}/\text{hyp} \\ \cos \theta * \text{hyp} &= \text{adj} & \cos \theta * \text{hyp} &= \text{adj} \\ \sin(U.\theta.\Phi) - (270 + (\text{ABS}(P.R.\Phi))) * u.\Phi &= u.v.\Phi & \cos((A.x.\theta.\Phi) - (\text{ABS}(P.R.\Phi))) * a.x.\Phi &= a.X.\Phi \\ * \cos(\text{ABS}(P.R.\Phi)) &= a.x.\text{SaH.A.}\Phi & * -\cos(\text{ABS}(P.R.\Phi)) &= a.x.\text{SaH.A.}\Phi \end{aligned}$$

u.SaH.V. Φ = $\cos(\text{ABS}(P.R.\Phi)) * \sin(U.\theta.\Phi) - (270 - \text{ABS}(P.R.\Phi))) * u.\Phi$	w.v. Φ = $-\cos(\text{ABS}(P.R.\Phi)) * \sin(W.\theta.\Phi) - (270 + (\text{ABS}(P.R.\Phi))) * w.\Phi$
--	--

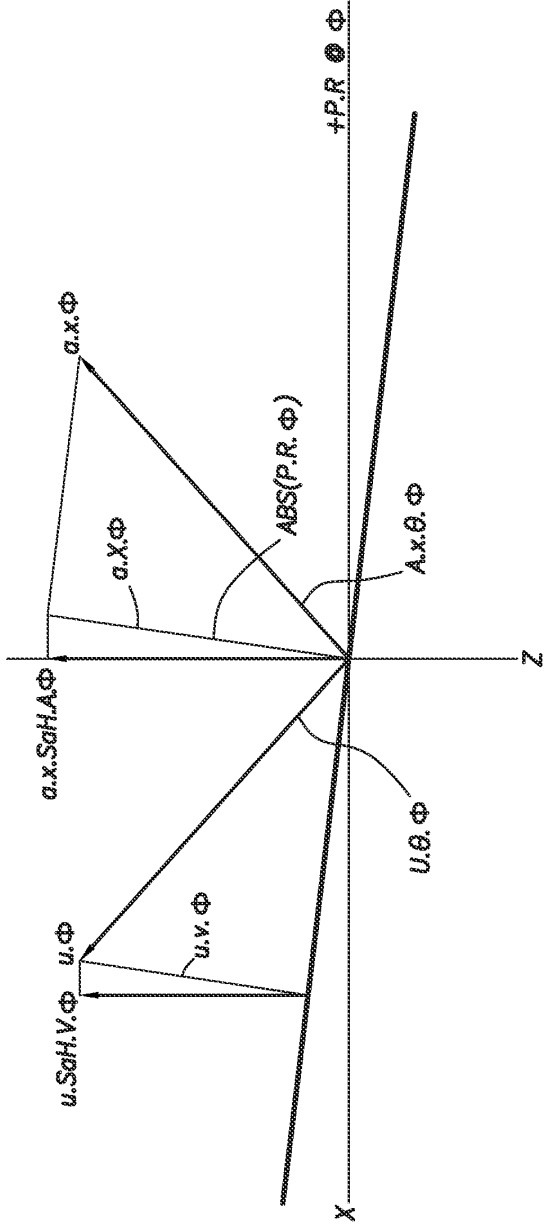


FIG.23F

GIMBALLED PARAVENE SURGE AS HEAVE VECTORS: NORMAL AND STROKE Φ PHASES Φ 180°-269°
PARAVENE PITCH / ROLL ANGLE (DEGREES, +CW/-CCW) = P.R. Φ

SURGE AS HEAVE VELOCITY (u.v) Φ Φ =u.v. Φ SURGE AS HEAVE ACCELERATION (a.x.a) Φ Φ =a.x.a. Φ

$\cos \theta = \text{adj} / \text{hyp}$
 $\cos \theta * \text{hyp} = \text{adj}$
 $\cos((U.\theta.\Phi - (\text{ABS}(P.R.\Phi))) * u.\Phi = u.v.\Phi$
 $* - \cos(\text{ABS}(P.R.\Phi)) * u.\text{SaH.V.}\Phi$
 $\cos \theta = \text{adj} / \text{hyp}$
 $\cos \theta * \text{hyp} = \text{adj}$
 $\cos(((180 + \text{ABS}(P.R.\Phi)) - A.x.\theta.\Phi)) * a.x.\Phi = a.X.\Phi$
 $* \cos(\text{ABS}(P.R.\Phi)) * a.x.\text{SaH.}\Phi$

$u.\text{SaH.V.}\Phi =$ $-\cos(\text{ABS}(P.R.\Phi)) * \cos(U.\theta.\Phi - (\text{ABS}(P.R.\Phi))) * u.\Phi$	$a.x.\text{SaH.}\Phi =$ $\cos(\text{ABS}(P.R.\Phi)) * \cos(((180 + \text{ABS}(P.R.\Phi)) - A.x.\theta.\Phi)) * a.x.\Phi$
--	---

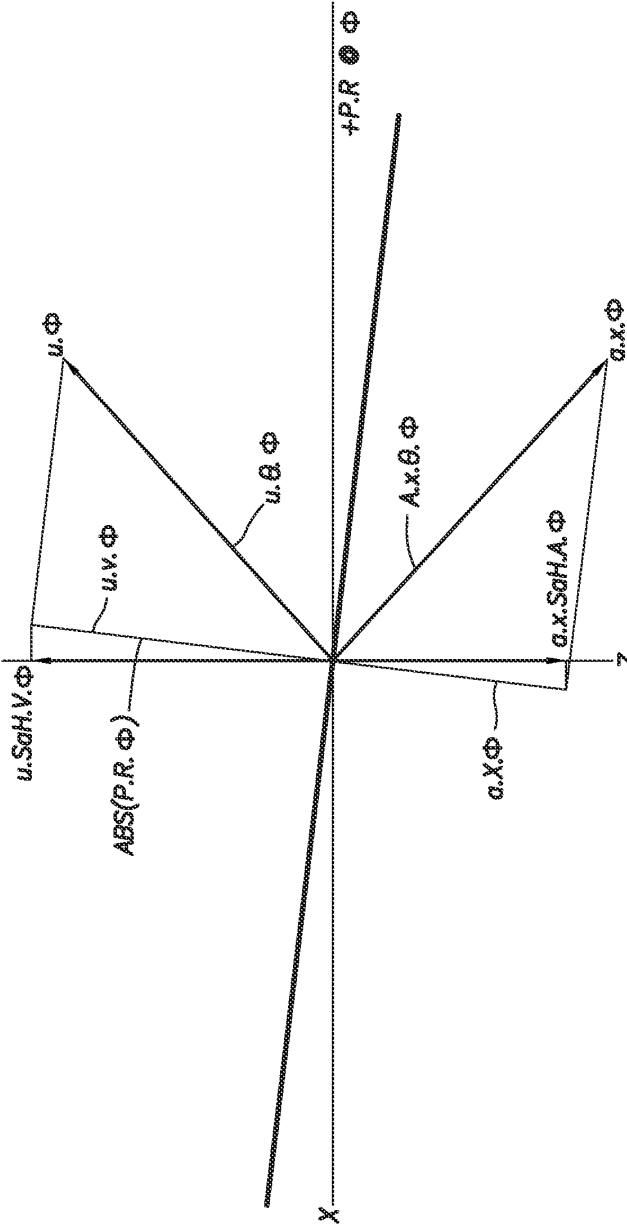


FIG.23G

GIMBALLED PARAVENE SURGE AS HEAVE VECTORS: NORMAL AND STROKE Φ PHASES Φ 270°-359°
PARAVENE PITCH / ROLL ANGLE (DEGREES, +CW/-CCW) = P.R. Φ

SURGE AS HEAVE VELOCITY (u.v) Φ Φ =u.v. Φ SURGE AS HEAVE ACCELERATION (a.x.a) Φ Φ =a.x.a. Φ

$$\begin{aligned} \cos \theta &= \text{adj/hyp} & \sin \theta &= \text{opp/hyp} \\ \cos \theta * \text{hyp} &= \text{adj} & \sin \theta * \text{hyp} &= \text{opp} \\ \cos(((180 - (\text{ABS}(\text{P.R.}\Phi)) - \text{U.}\theta.\Phi)) * \text{u.}\Phi) &= \text{u.v.}\Phi & \sin((\text{A.x.}\theta.\Phi - (270 - \text{ABS}(\text{P.R.}\Phi))) * \text{a.x.}\Phi) &= \text{a.x.}\Phi \\ * \cos(\text{ABS}(\text{P.R.}\Phi)) &= \text{u.SaH.V.}\Phi & * \cos(\text{ABS}(\text{P.R.}\Phi)) &= \text{u.}\Phi \end{aligned}$$

u.SaH.V. Φ =	a.x.SaH. Φ =
$\cos(\text{ABS}(\text{P.R.}\Phi)) * \cos(((180 - \text{ABS}(\text{P.R.}\Phi)) - \text{U.}\theta.\Phi)) * \text{u.}\Phi$	$-\cos(\text{ABS}(\text{P.R.}\Phi)) * \sin((\text{A.x.}\theta.\Phi - (270 - \text{ABS}(\text{P.R.}\Phi))) * \text{a.x.}\Phi$

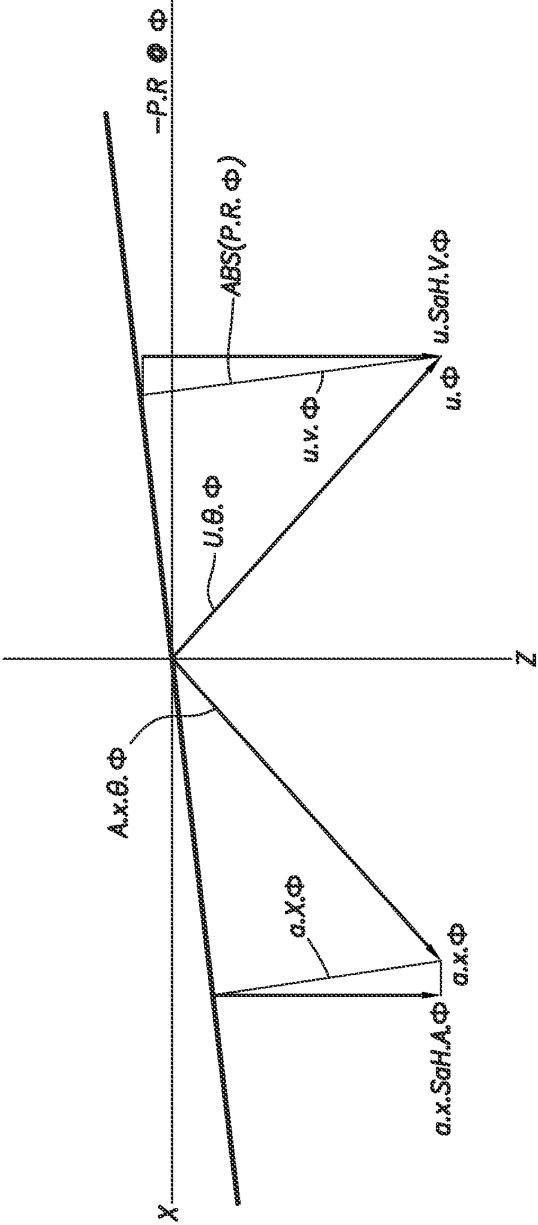


FIG.23H

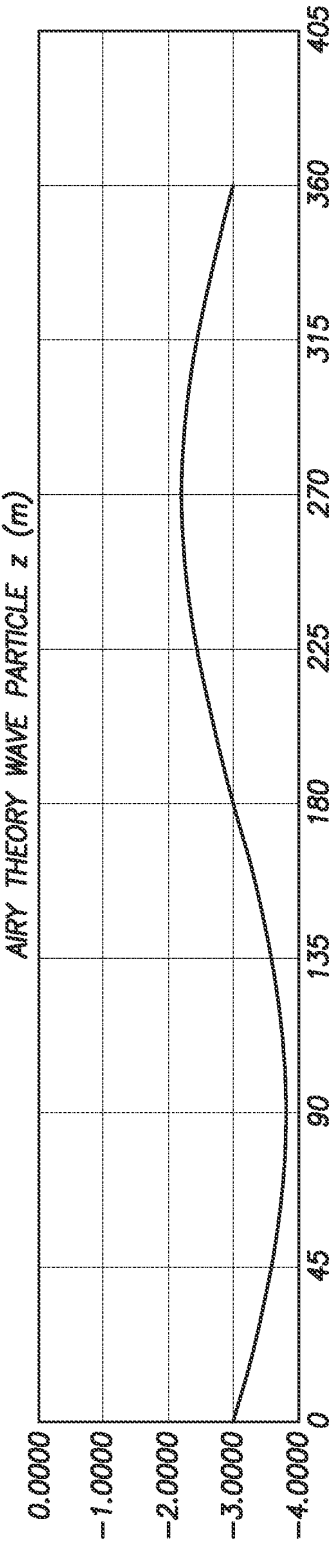


FIG. 25A

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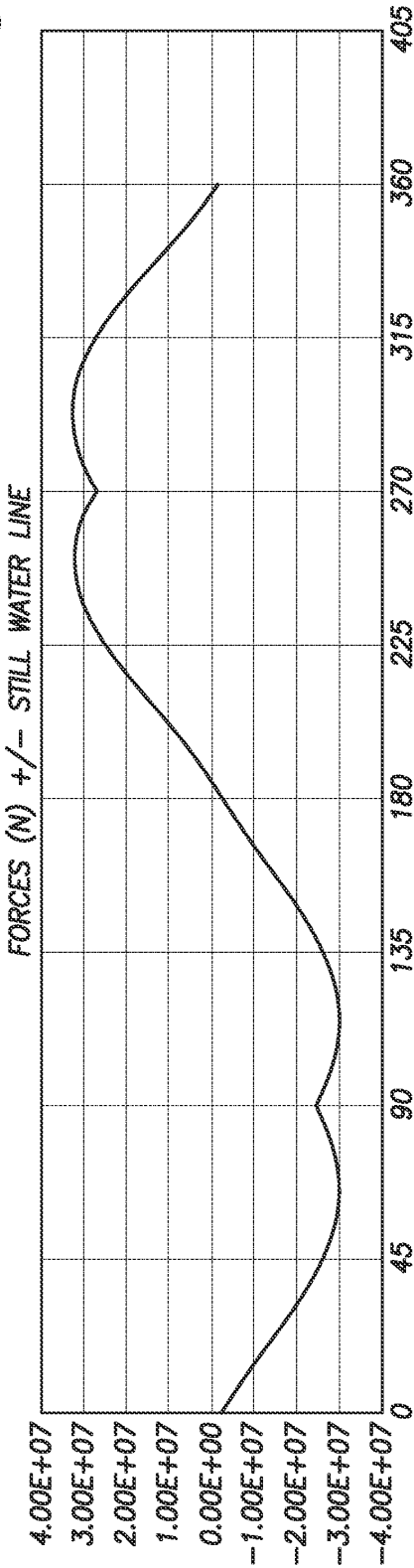
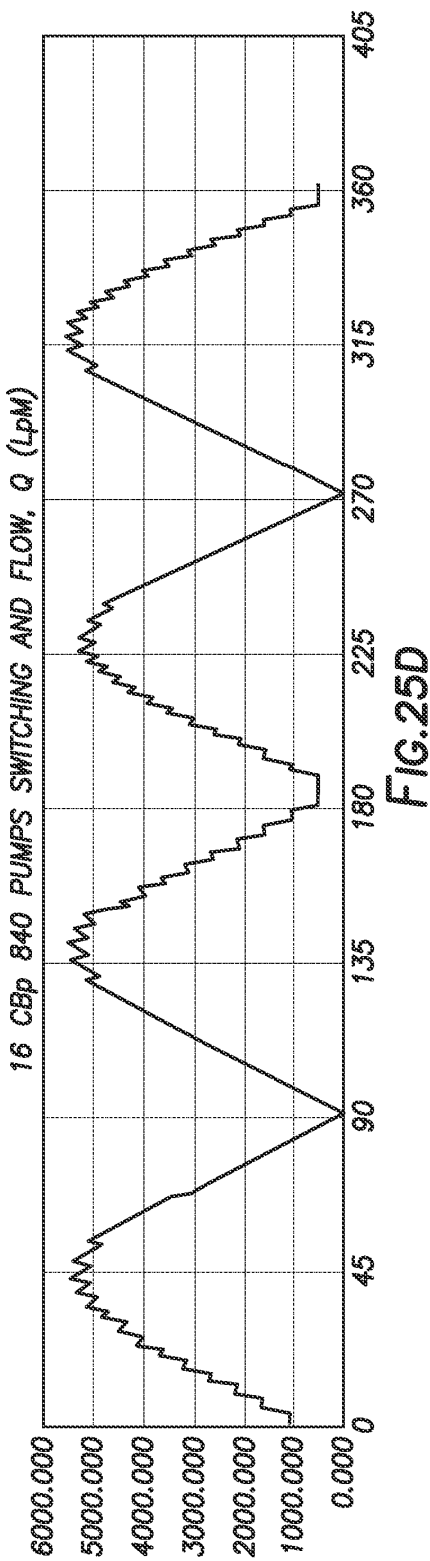
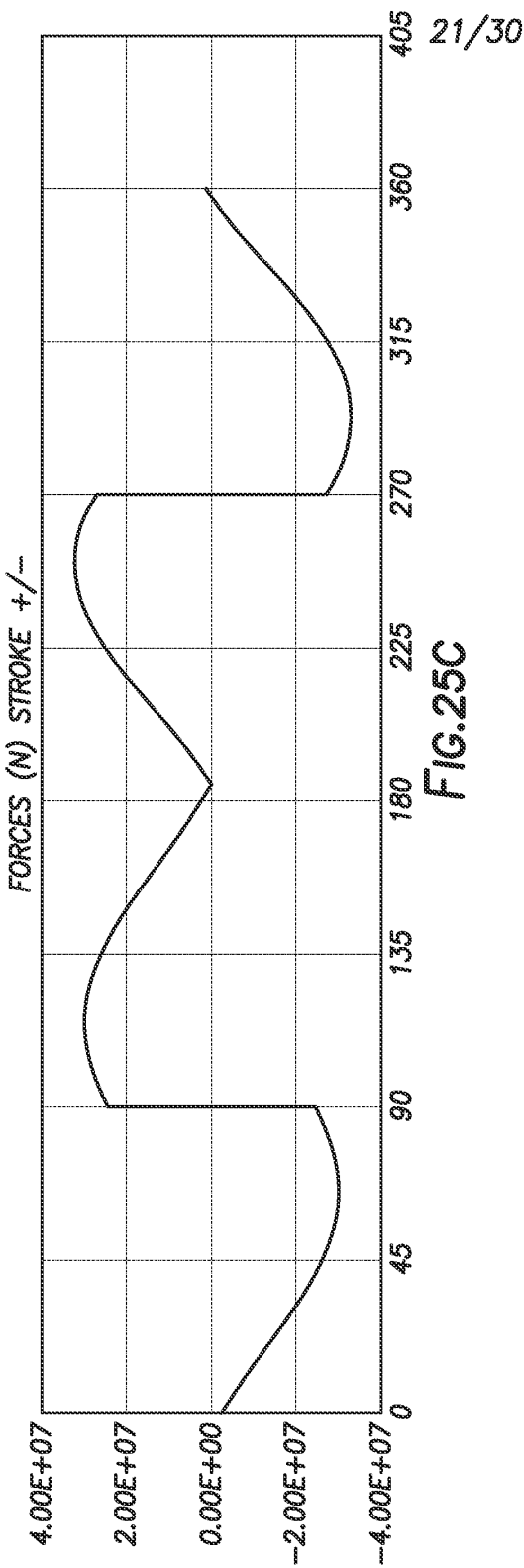


FIG. 25B



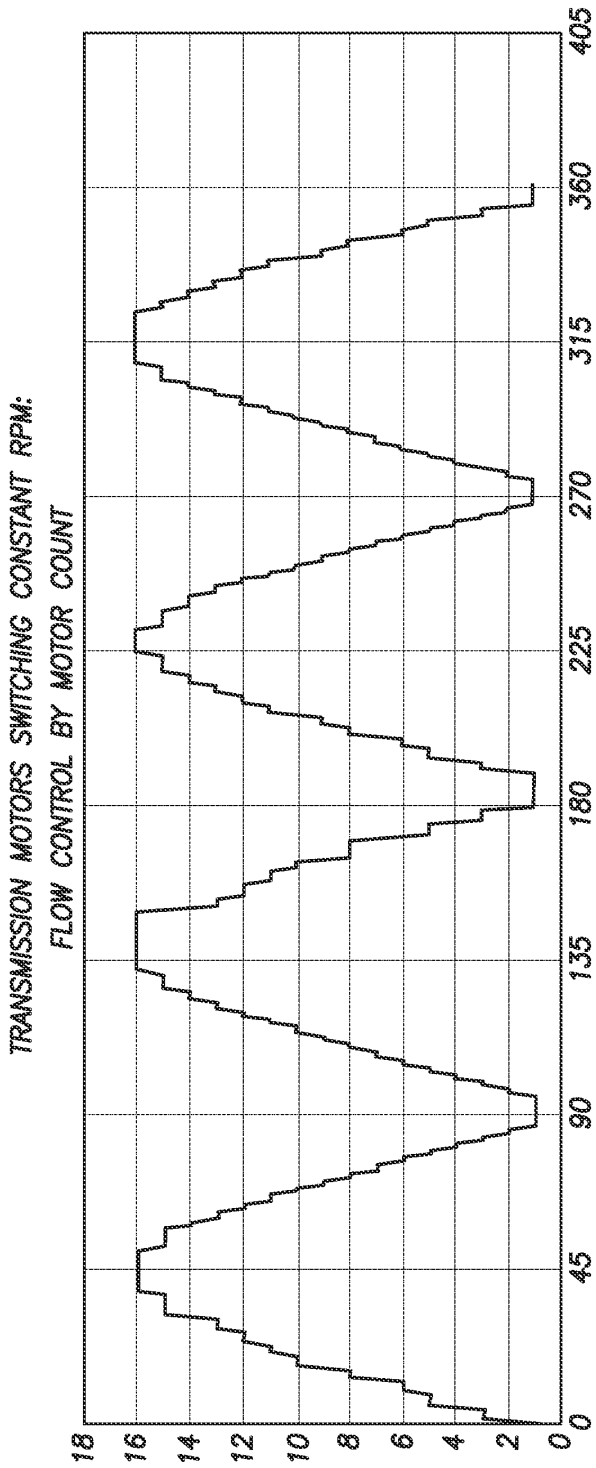


FIG.25E

KANEHOE MEAN: GENERATORS' 16 CBp MOTORS SWITCHING,
2 GEAR BOX RATIOS TEST; 1,200 RPM CONTINUOUS

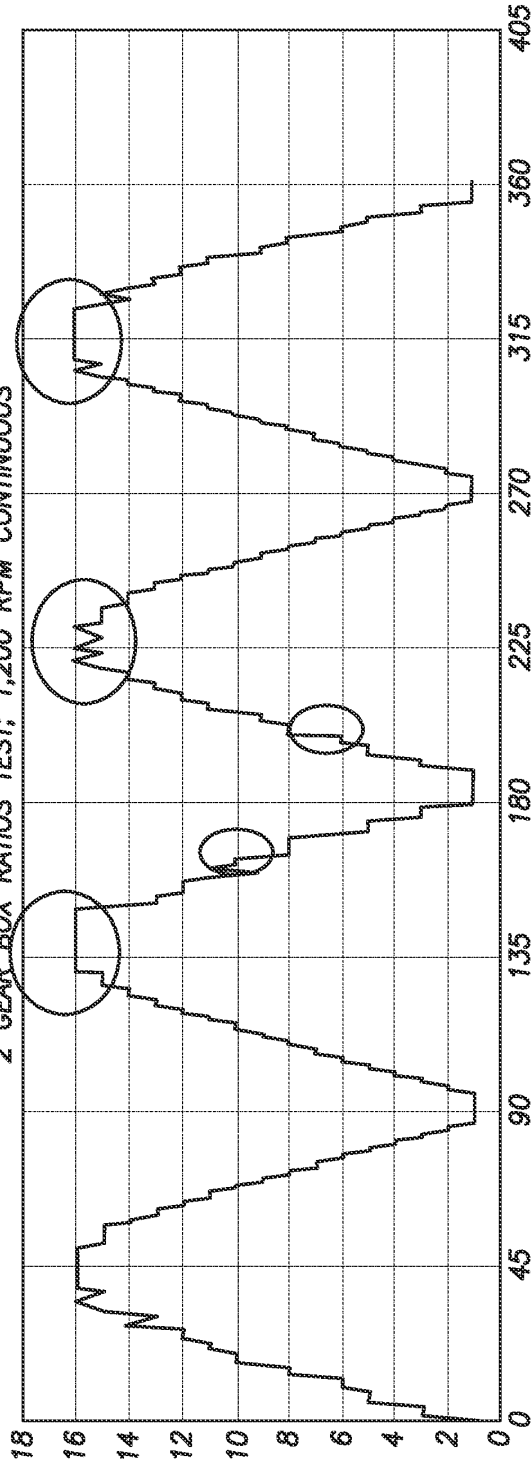


FIG.26

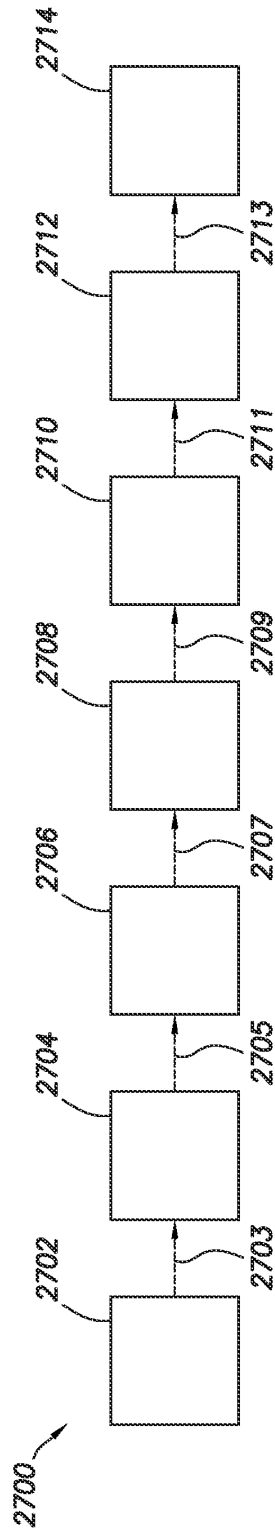


FIG.27

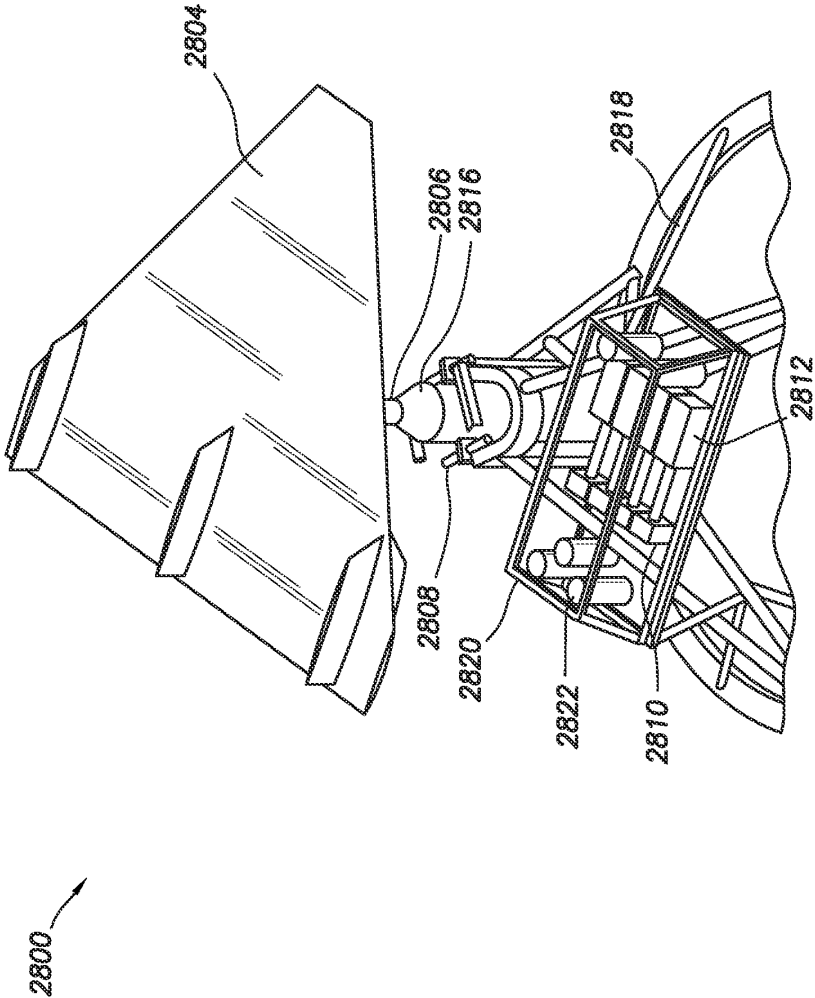
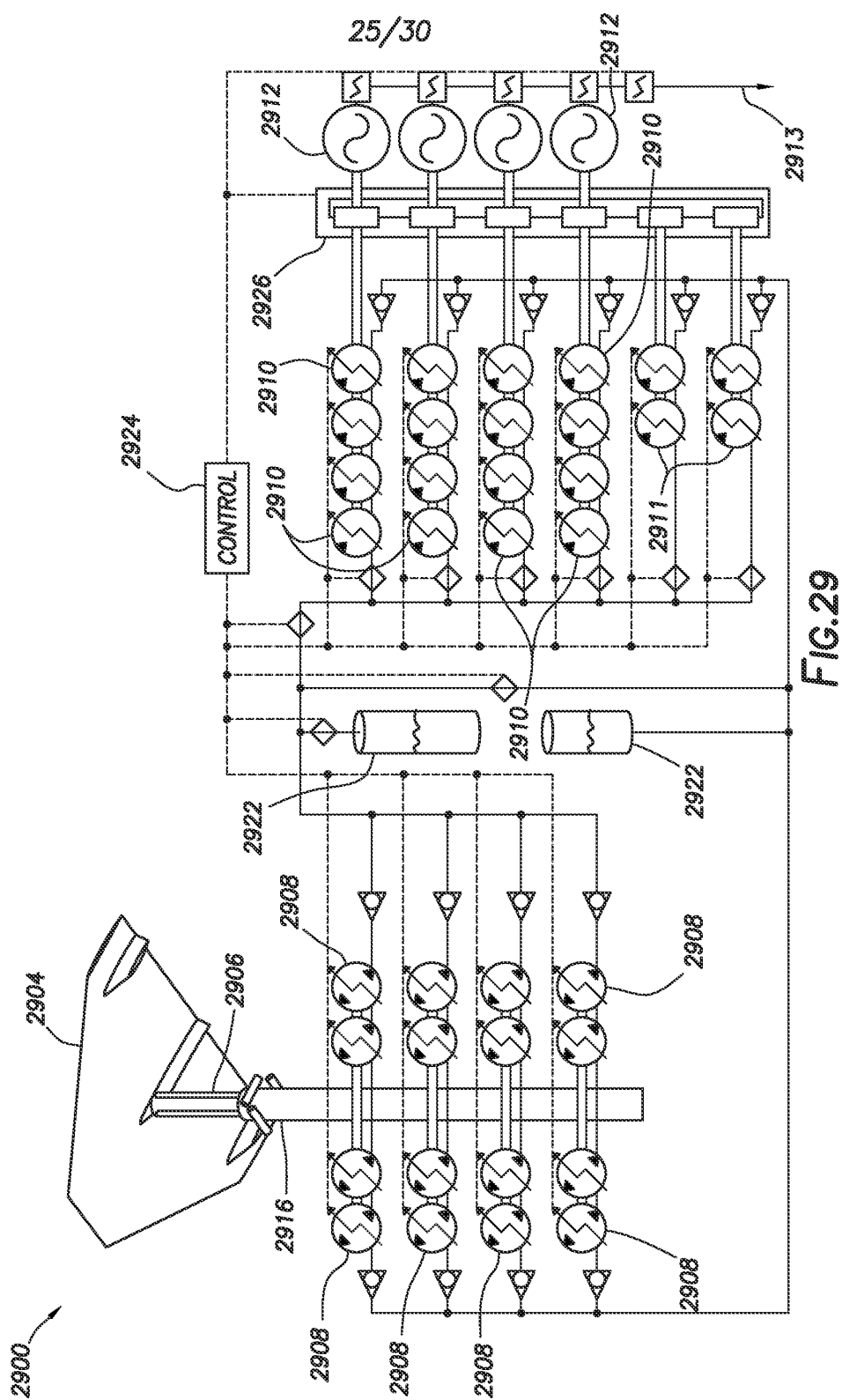


FIG. 28



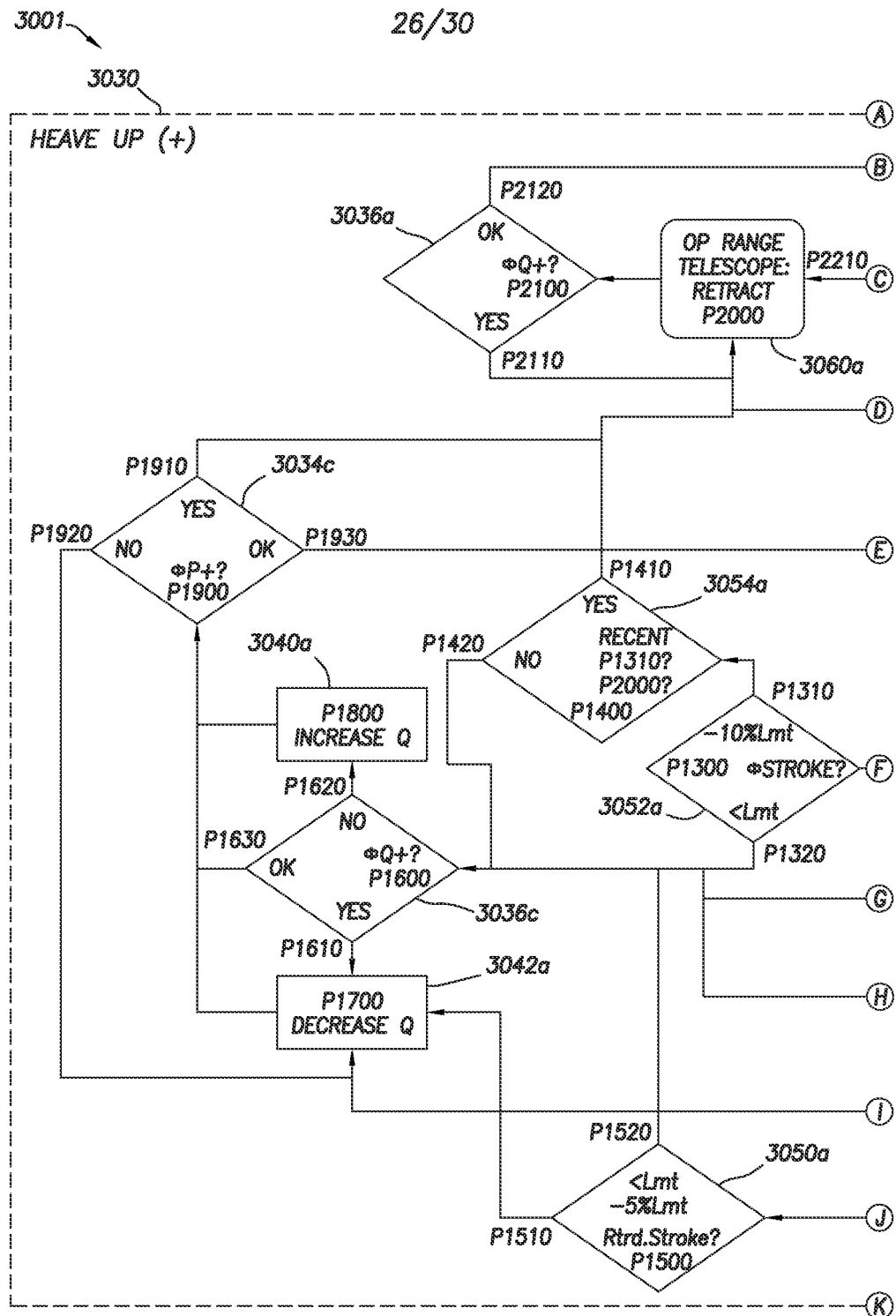


FIG.30A

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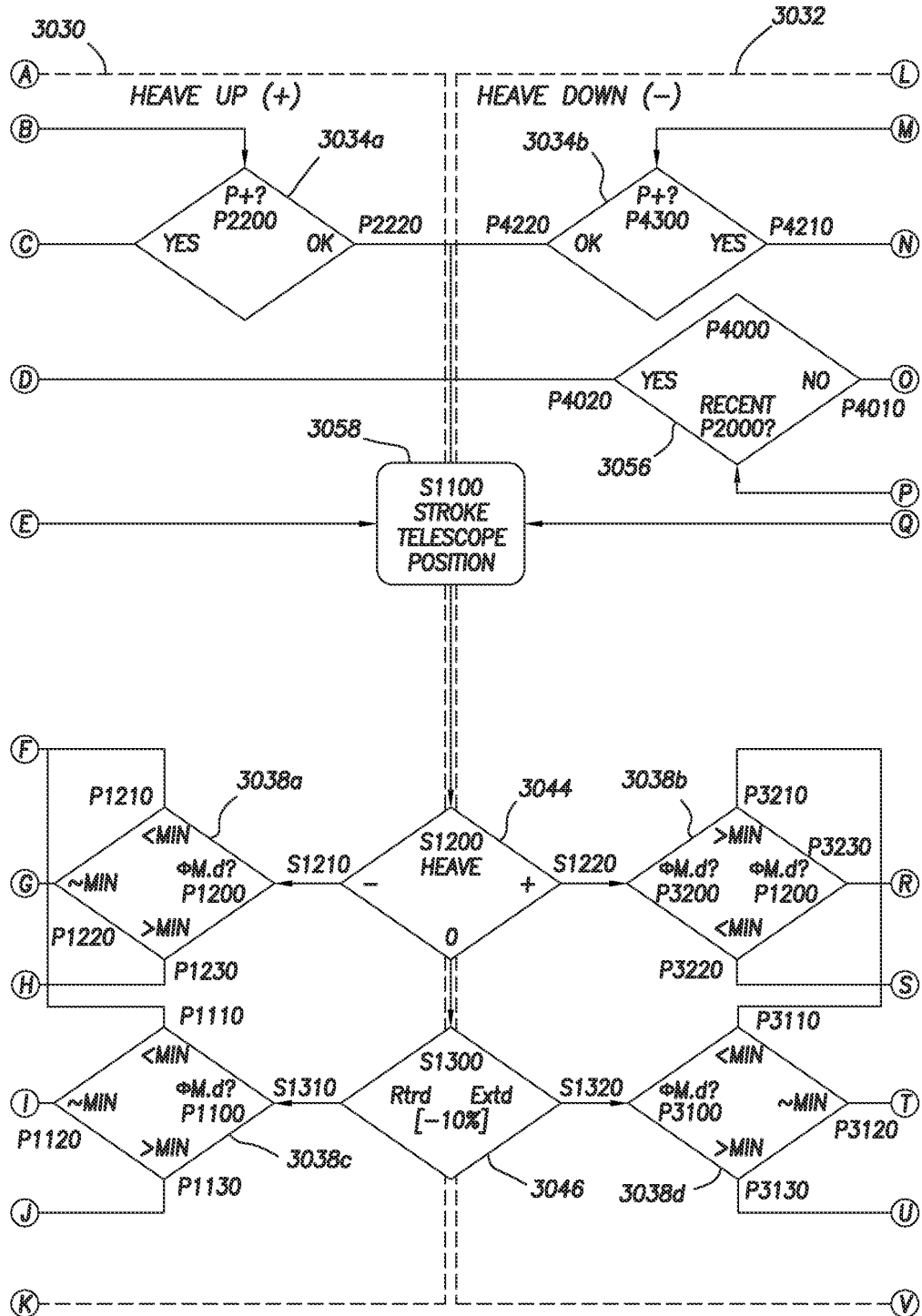


FIG. 30B

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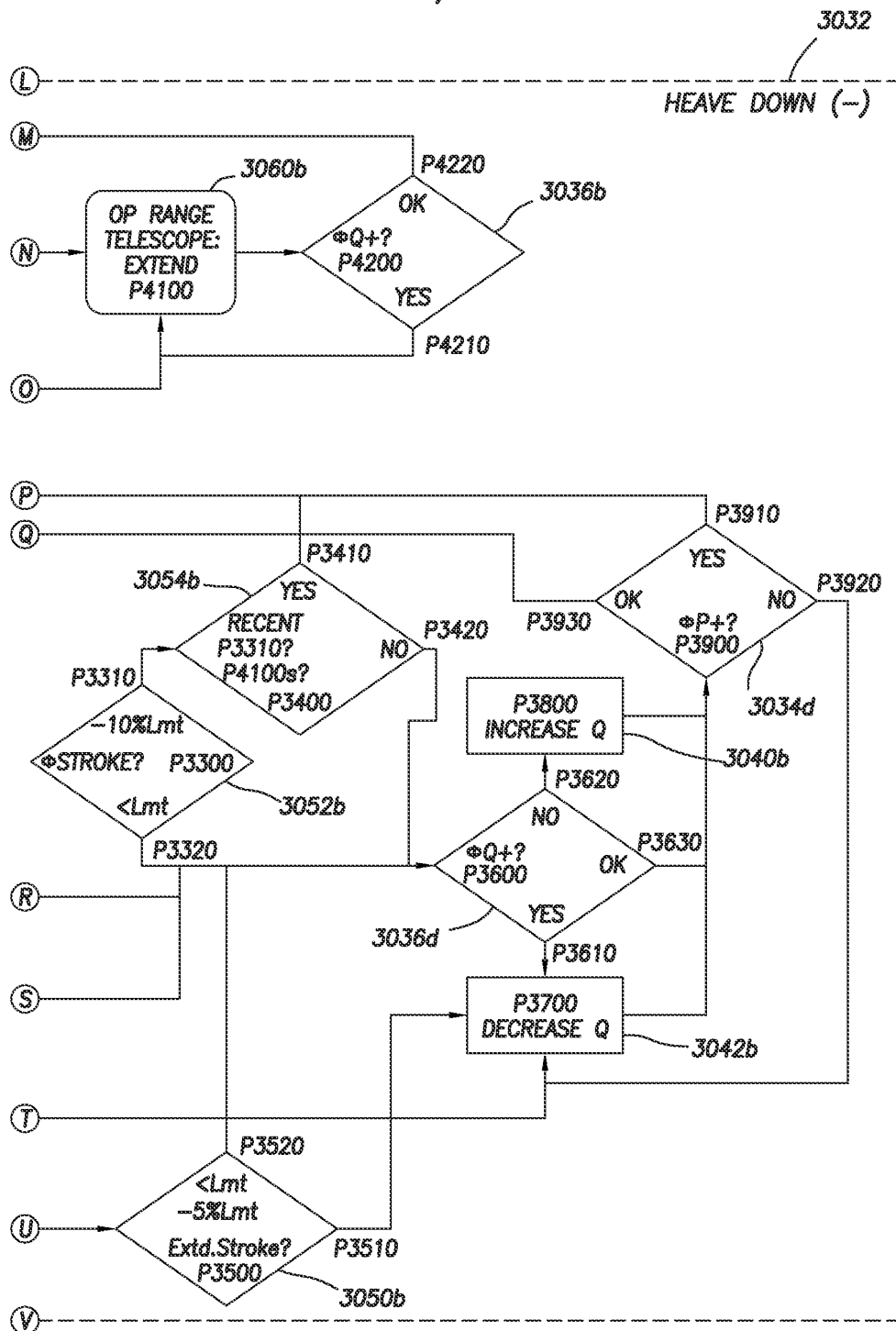
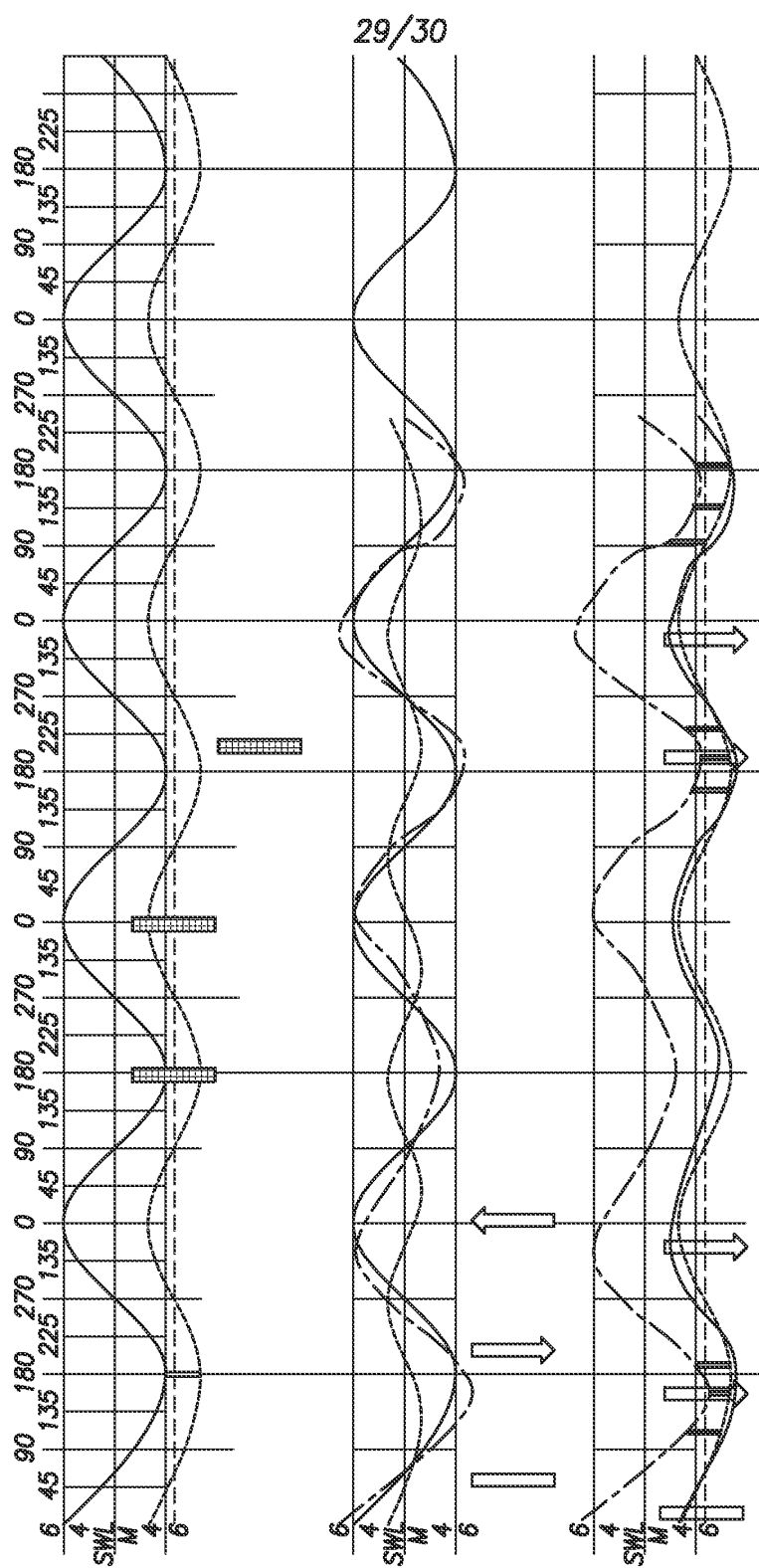
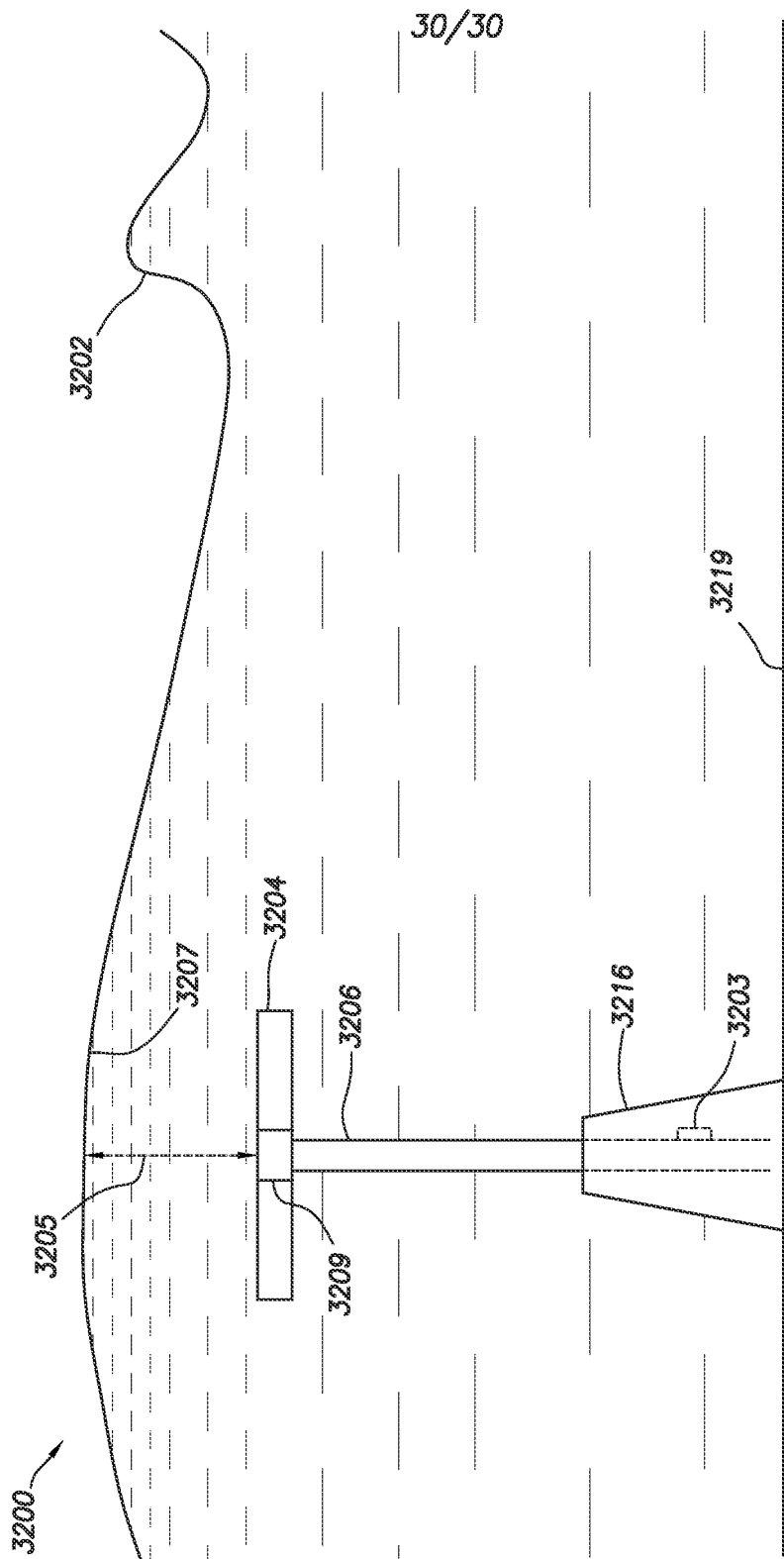


FIG. 30C



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FIG.32