

**ELEMENT ONE:** An electro-mechanical reactor environment (EMRE) which provides an effective “Phase Space” environment to: 1) unpack the GTRP, re-set the vulcanization pre-cursor for 2) subsequent sulfidic bridge realignment, 3) with minimal alteration to the native, elastomer-filler matrix.

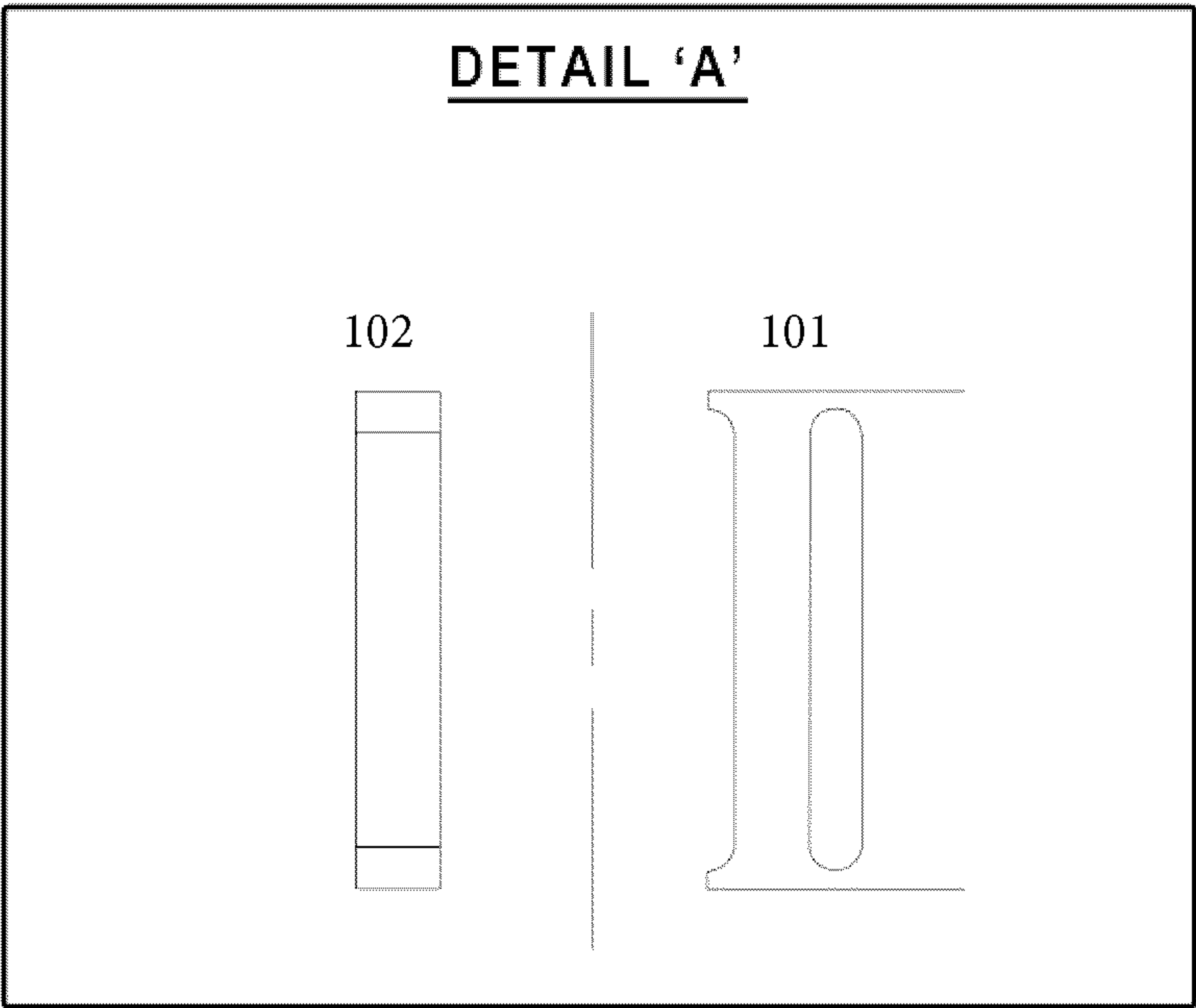
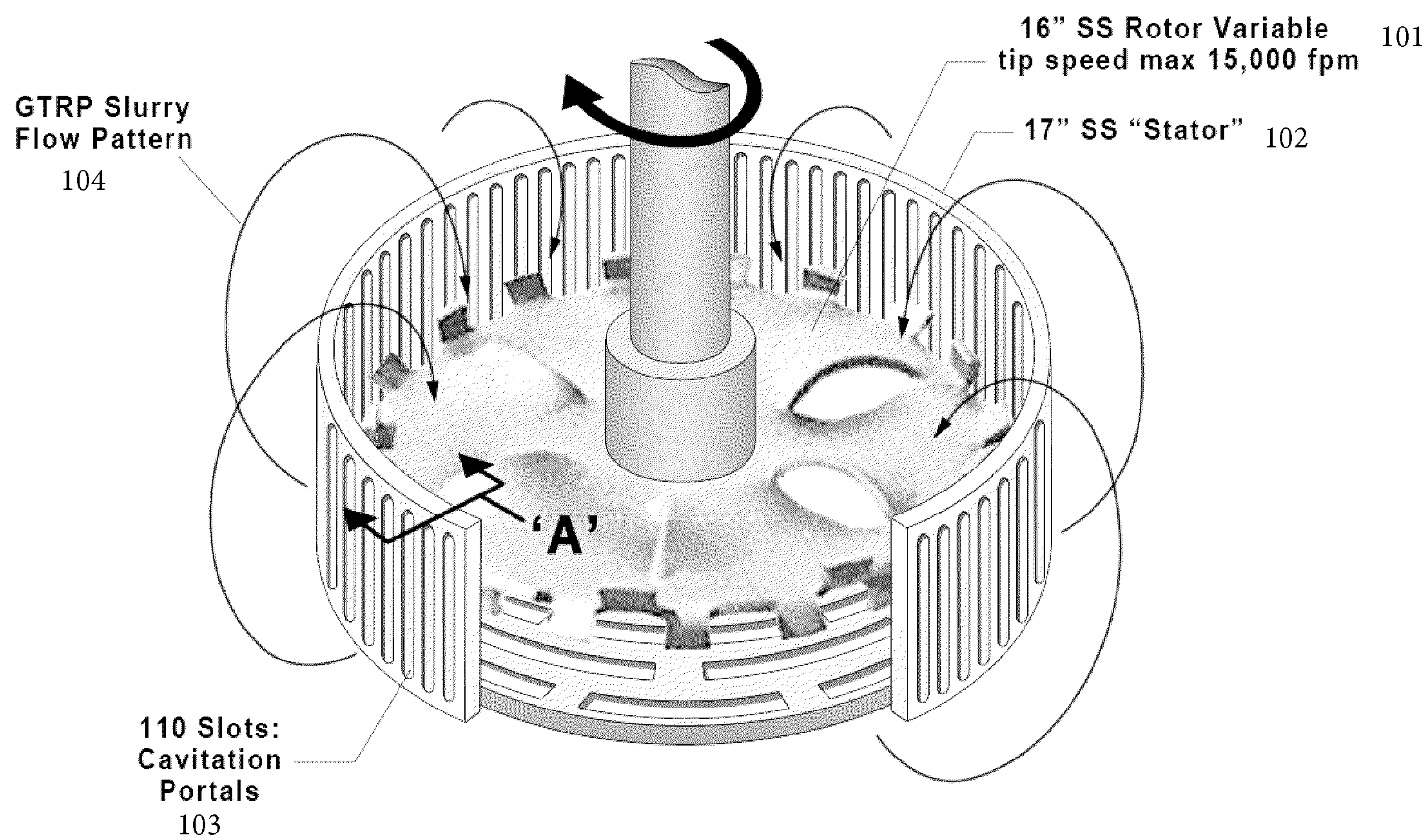


FIG. 1

ELEMENT TWO: Prepare GTRP Slurry for EMRE

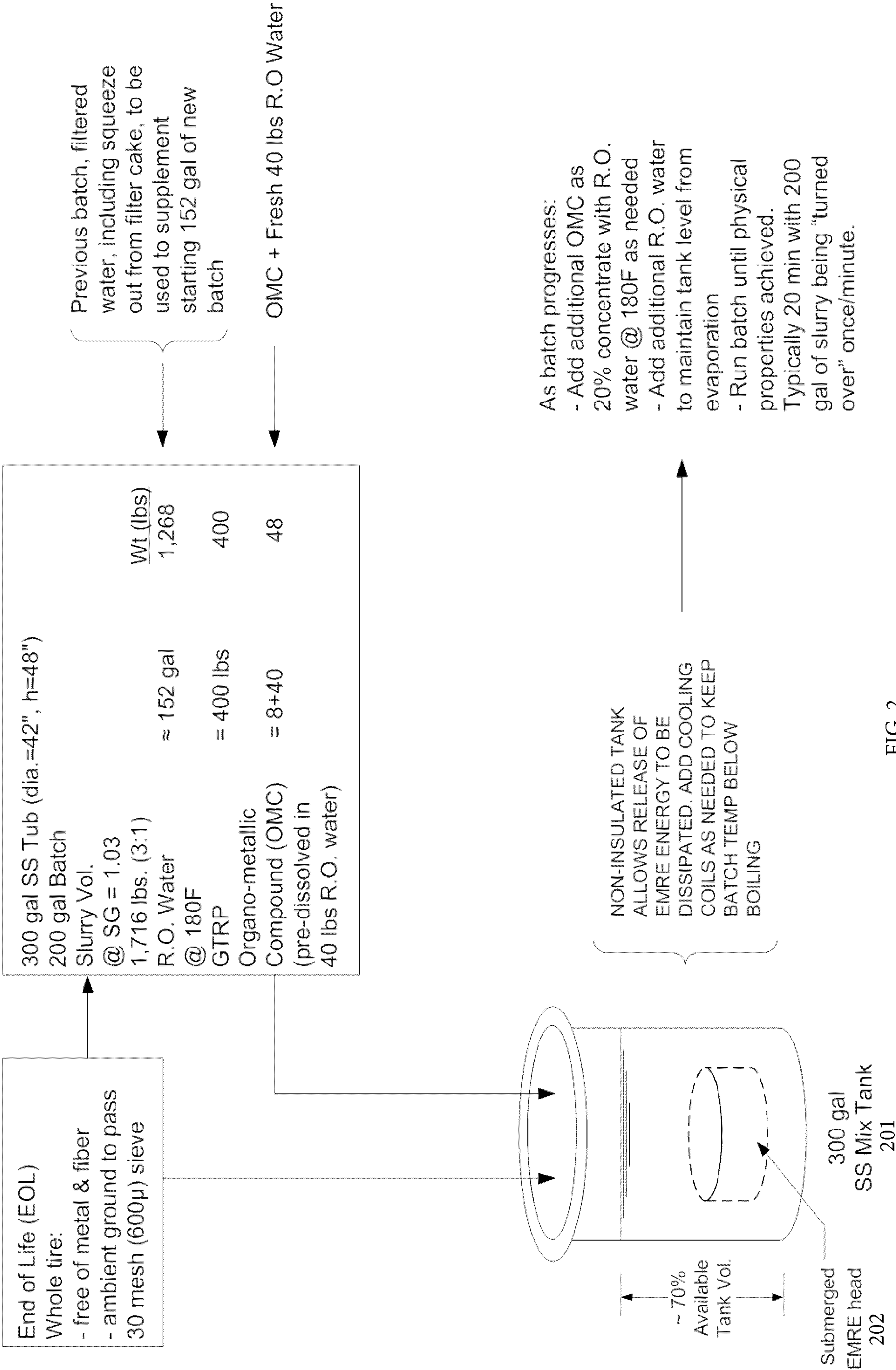


FIG. 2

ELEMENT THREE: GTRP Traverses ‘Phase Space Tunnel’; differential-cyclical, mechanical stress and steric field-polarization.

|                      |                                                                                                             |                                                                                                              |                                                                                                              |                                                                                                              |                                          |  |  |  |  |  |  |  |
|----------------------|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------------------------------------------|--|--|--|--|--|--|--|
| TIMELINE             | <div>0.000 sec<div>0.0007 sec</div><div>+0.0012 sec</div></div>                                             |                                                                                                              |                                                                                                              |                                                                                                              |                                          |  |  |  |  |  |  |  |
| LINEAR DISTANCE      | <div>0.50" → STATOR COMPRESSION → 0.25" → EXIT STATOR → ≤ 20' → RECIRCULATION PATTERN*</div>                |                                                                                                              |                                                                                                              |                                                                                                              |                                          |  |  |  |  |  |  |  |
| GTRP GEOMETRY        | <div><br/>d ≤ 600μ</div> | <div><br/>w/l ≈ 3.1</div> | <div><br/>w/l ≈ 6.1</div> | <div><br/>w/l ≈ 3.1</div> | <div>d ≤ [600μ] − [(600) [1/20]] N</div> |  |  |  |  |  |  |  |
| VELOCITY             | GTRP Recirculation Speed<br>0.25 MPH                                                                        | Tip Speed<br>~ 90 MPH                                                                                        | GTRP Enters Compression Gate<br>~ 90 MPH                                                                     | Cavitation Range<br>~ 90 MPH<br>~ 400 MPH                                                                    | Average Increase<br>~ 245 MPH            |  |  |  |  |  |  |  |
| ACCELERATION PROFILE | ~ 5,800 G's<br>0 – 52,700 G's                                                                               |                                                                                                              |                                                                                                              |                                                                                                              |                                          |  |  |  |  |  |  |  |

\* 600μ particle with ~1200 transverse sulfidic-crosslinks; 60 regenerated vulcanized pre-cursor sites/pass.

FIG. 3A

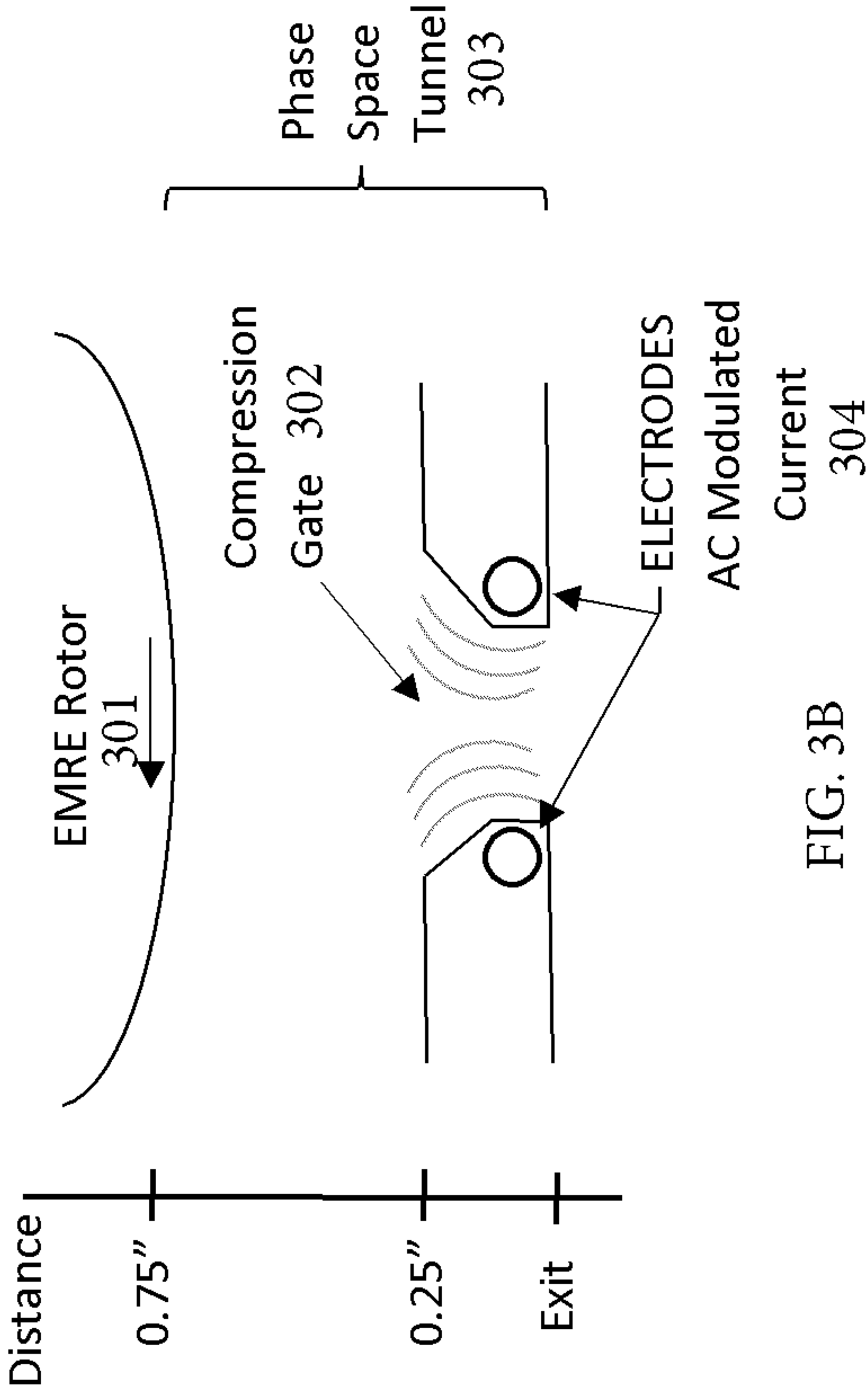
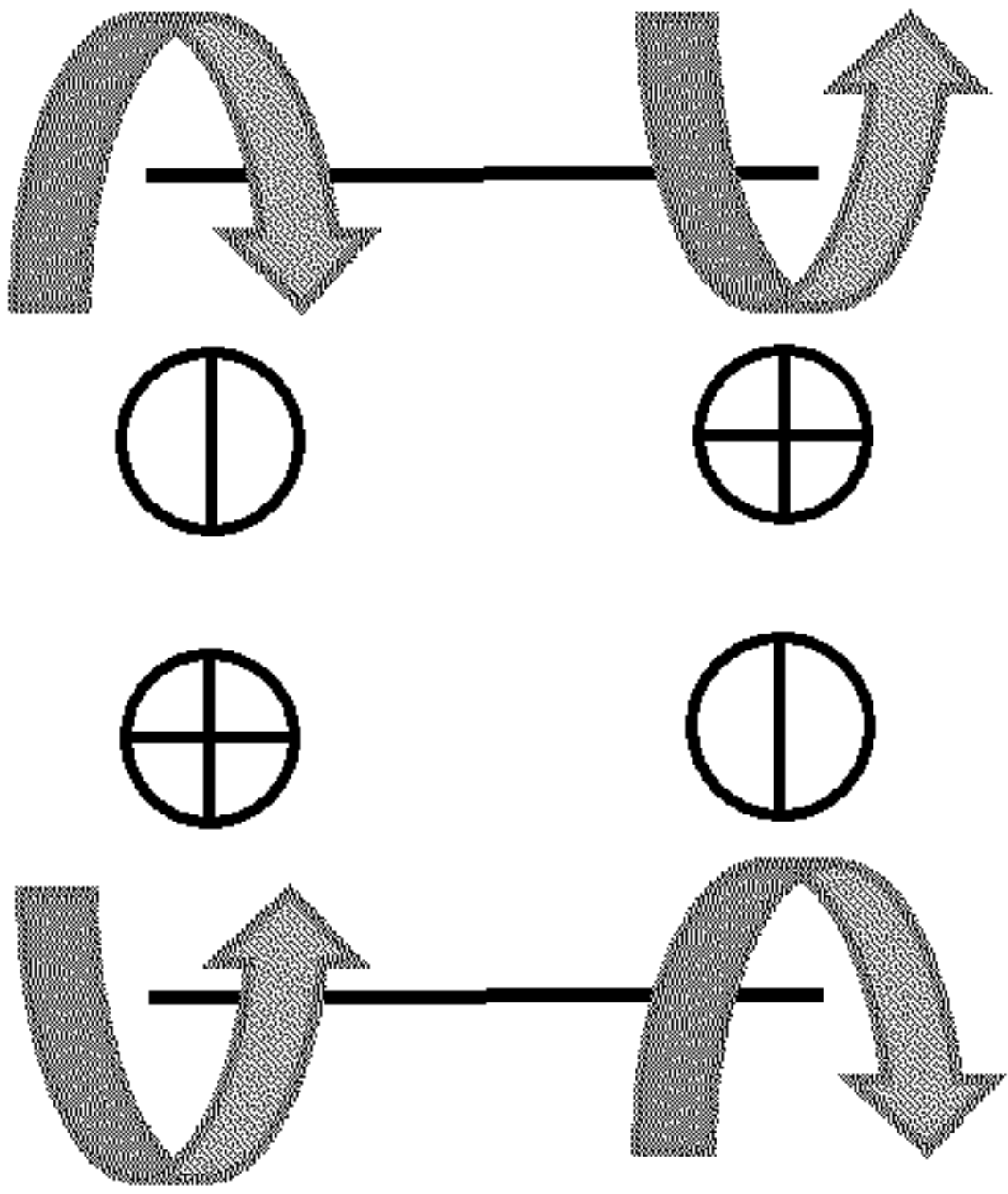


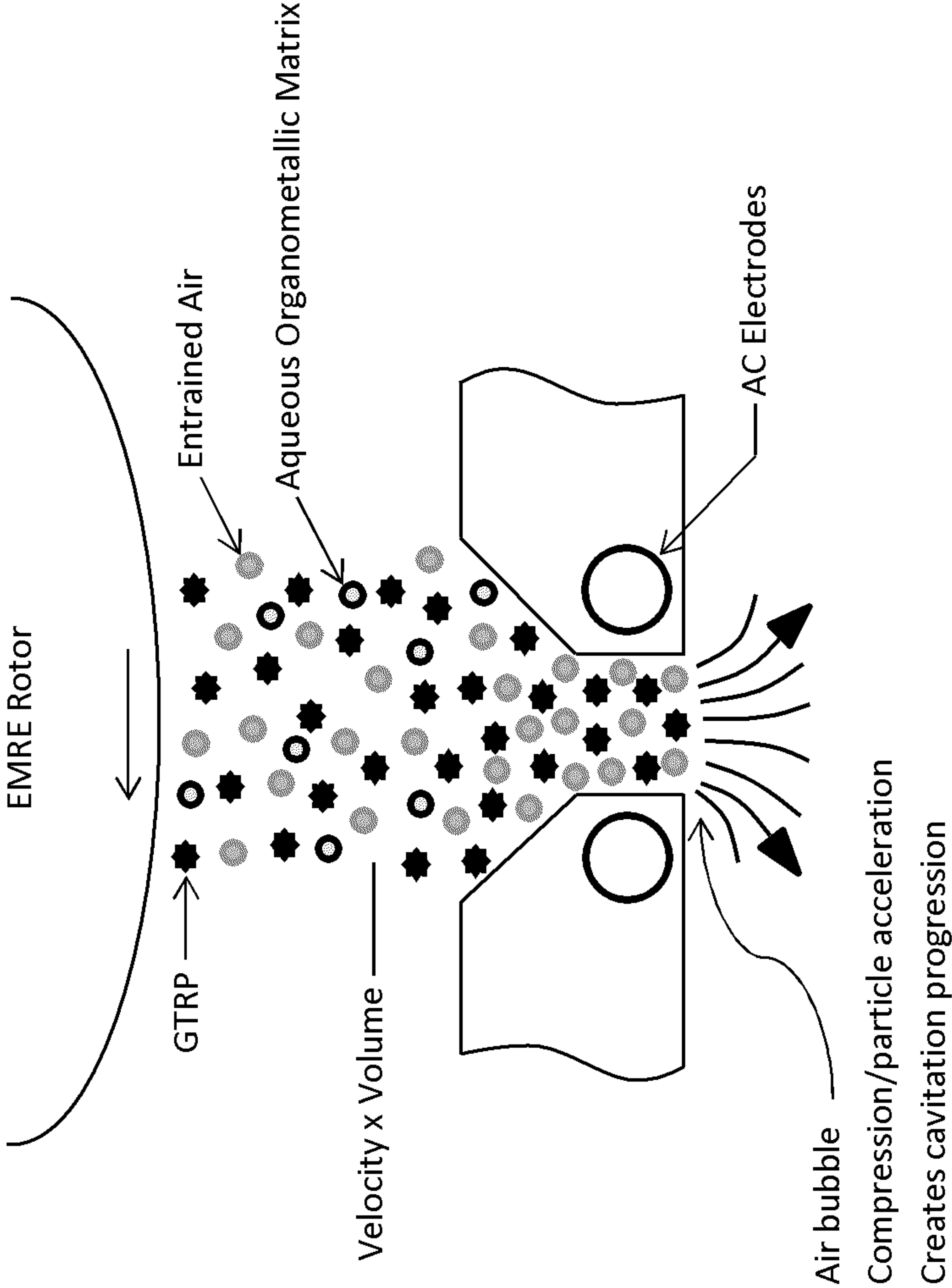
FIG. 3B



Trampoline effect of rapid compression-stretching-decompression; and/or oscillating AC current, enhances steric effect of repulsion between overlapping electron clouds with subsequent accelerated delamination of GTRP bound matrix.

FIG. 3C

ELEMENT FOUR: Engineered, Cavitation-Induced, Acoustic Shockwave.



As slurry exits, lower pressure completes cavitation cycle with implosion of air cavity.  
Extreme temperature and pressure differential excursion within cavitation cone in range of:  
Temperature:  $10^2 - 10^{15}$  °F  
Acoustic Wave Velocity: 60 – 180 m/sec  
Time Interval:  $10^3 - 10^8$  (sec<sup>-1</sup>)

Changing rotation speed of EMRE Rotor and/or slurry viscosity and/or stator gap allows manipulation of energy “leverage” within “Phase Space” .

FIG. 4A

GTRP SLURRY & EMRE PROCESS  
CONTROL VARIABLES

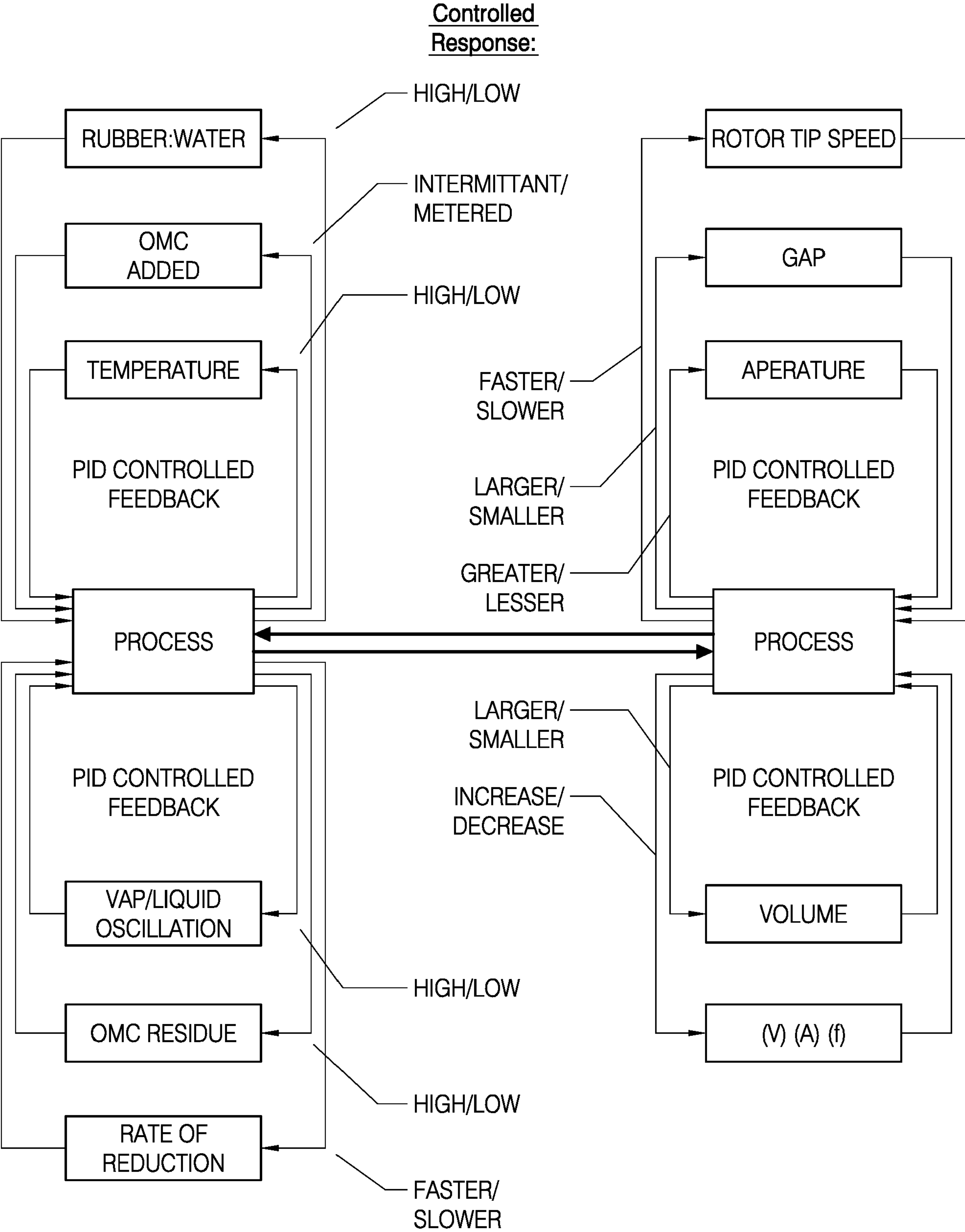


FIG. 4B

| COMPONENT                                                             | METHOD OF CONTROL                                                                                                                                              | ABBREV.                 | FIRST ORDER RESULT         |                                                                                                                                                                                                               | DATA GATHERING HARDWARE                                                                                                                                               |
|-----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RUBBER-TO-WATER DENSITY                                               | PRE-BATCH RECIRCULATION RESERVOIR MIX                                                                                                                          | R:W                     | HIGHER:<br>LOWER:          | INCREASE PHASE SPACE TUNNEL PARTICLE COLLISION<br>LOWER REACTOR YIELD; MORE PRECISE END PRODUCT/ENERGY                                                                                                        | BATCH MASS; VOL PROGRAMMABLE ELEMENT VISCOSITY DELTA OUPUT                                                                                                            |
| CHEMICAL (OMC) SEQUENCE                                               | INTERMITTANT BULK ‘DROPS’ OR METERED                                                                                                                           | OMC ADDED               | INTER-MITTANT:<br>METERED: | FASTER BATCH TIMES W/ LARGER FINAL PARTICLE SIZE<br>EFFICIENT-TARGETED OMC METATHESIS                                                                                                                         | METERING PUMP CONTROLLED BY APP                                                                                                                                       |
| SLURRY TEMPERATURE                                                    | RECIRCULATION RESERVOIR JACKET TO HEAT &/or COOL                                                                                                               | TEMP.                   | HIGHER:<br>LOWER:          | INCREASE OMC COORDINATION COMPLEX FUNCTION; PLUS PENETRATION OF AQUEOUS MEDIUM TO PARTICLE CORE<br>DEFER PHASE SPACE PARTICEL MANIPULATION TO CAVITATION EFFECT & PHOTON BLOCKADE                             | MULTI-POINT SENSORS TO CORRELATE W/ OTHER SENSOR INPUT FOR INTEGRATED OPTIMIZATION                                                                                    |
| SLURRY PRESSURE ACHIEVED WHERE SLURRY PUMPED THROUGH (PCMR) IN-SERIES | PARALLEL CONTINUOUS FLOW MICRO-SYNTHESIS REACTOR 2ND STAGE SERPENTINE PIPE MODULE WHERE SLURRY TEMPERATURE: PRESSURE MANIPULATE VAPOR/LIQUID PHASE OCILLATIONS | VAPOR LIQUID OCCILATION | HIGHER:<br>LOWER:          | AUGMENT'S PHOTON BLOCKADE PRESERVES ENTROPY LOSS W/ MORE PARTICLE SIZE REDUCTION/UNIT OF INPUT ENERGY<br>DEFERS PHASE SPACE PARTICLE MANIPULATION TO ELECTROMAGNEICS OF DUAL ELECTRODE ELEMENT IN STATOR SLOT | TEMPERATURE & PRESSURE SENSORS PLUS IRIS VALVE CONTROLS TO SET NUMBER OF PRESSURE GRADIENT CHANGES DURING PCMR PASSAGE TIED TO MASTER PROGRAM                         |
| POST REACTOR PARTICLE DE-WATERING SELECTION                           | FILTER-PRESS THEN DEHYDRATE OR FULL DEHYDRATION                                                                                                                | OMC RESIDUE             | HIGHER:<br>LOWER:          | REMAINING REACTIVE OMC ASSISTS IN HIGH SHEAR COMPOUNDING INTO MACRO-STRUCTURE BY DRY METATHESIS OF ‘ORPHAN’ BONDS<br>REDUCES OMC DEMAND IN SUBSEQUENT BATCH; FASTER POST REACTOR PROCESS TIME                 | MONITOR X LINK DENSITY; TENSILE STRENGTH AND RESILIENCE PROPERTIES OF COMPOUNDED RUBBER MACRO-STRUCTURE THEN CORRELATE FOR EFFICACY                                   |
| PARTICLE SIZE REDUCTION; AND RATE OF REDUCTION                        | USE ALL OTHER SYSTEM VARIABLES IN BOTH SLURRY CONTROL AND EMRE CONTROLS                                                                                        | RATE OF REDUCTION       | FASTER:<br>SLOWER:         | SHORTER BATCH INTERVALS WITH ENERGY ECONOMIES W/O LOSS OF FINAL PURPOSE OF PROCESS<br>REDUCED POST-PROCESSING OF DRY, REACTOR MODIFIED GTRP                                                                   | SAME AS V. SAMPLING, DURING BATCH W/ PARTICLE SIZE ANALYZER AND PHYSICAL SMEAR TEST OVER 5μ GRATING TO DETERMINE OUTER DIMENSION AVERAGE AND PARTICLE CORE RESILIENCY |

FIG. 4C.

| COMPONENT                                                                                                          | METHOD OF CONTROL                                                                                                  | ABBREV.           | FIRST ORDER RESULT                             |                                                                                                                                                      | DATA GATHERING HARDWARE                                                                    |
|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-------------------|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| SPEED<br>ROTOR TIP RPM                                                                                             | VARIABLE FREQUENCY DRIVE                                                                                           | ROTOR TIP SPEED   | FASTER:<br>SLOWER:                             | MORE DISTORTION<br>REDUCED CAVITATION EFFECT                                                                                                         | HARD WIRED, PROGRAM<br>FREQ, RPM, AMP, VOLT: TO<br>MOTOR                                   |
| ROTOR TIP-TO-<br>STATOR<br>DISTANCE                                                                                | MECHANICALLY<br>ESTABLISHED PRIOR TO<br>RUNNING                                                                    | GAP               | LARGER:<br>SMALLER:                            | INCREASE MIXING INGREDIENT &<br>REACTION TIME<br>MAINTAIN PARTICLE VELOCITY &<br>MAXIMIZE CAVIATION EFFECT                                           | CHART RESULT FOR<br>DIFFERENT GAPS VS<br>FINISHED PRODUCT AS<br>DATA ENTRY POINT -<br>PRGM |
| STATOR GAP<br>APERATURE<br>SHAPE & AREA                                                                            | ADJUSTABLE,<br>CONCENTRIC DUAL<br>SHELL PLATES SET-UP<br>BEFORE RUNNING OR<br>ADJUSTABLE ON-THE-<br>FLY            | APERATURE         | GREATER:<br>LESSER:                            | ACCOMMODATE SMOOTH FLOW OF<br>LARGE PARTICLE AT START OF<br>REACTOR RUN<br>IMPROVE CAVITATION EFFECT OF<br>SMALLER PARTICLE LATE IN RUN              | PRE-BATCH FUNCTION TO<br>BE DETERMINED AND<br>ENTERED AS A<br>PROGRAMMABLE<br>ELEMENT/APP  |
| RECIRCULATION<br>RESEVOIR<br>VOLUME                                                                                | PRE-SET VOLUME FOR<br>SINGLE OR MULTI-<br>STAGE PROCESS<br>TARGET(S)                                               | VOLUME            | LARGER:<br>SMALLER:                            | IMPROVED DIELECTRIC RELAXATION;<br>UNIFORM GROUND STATE<br>HIGHER PHASE SPACE TUNNEL<br>ENERGY RETENTION                                             | PRE-BATCH FUNCTION;<br>CALCULATE AS PROGRAM<br>ELEMENT APP                                 |
| STATOR<br>APERATURE<br>PASSAGE WAY<br>EMBEDDED,<br>OVAL<br>ELECTRODE<br>GATE WIRED TO<br>HIGH VOLTAGE<br>AC SOURCE | POWER CONTROL<br>MODULE WITH<br>VARIABLE: FREQUENCY,<br>VOLTAGE, AMPERAGE<br>CONTROLS<br>(V) (A) (f) = 3 VARIABLES | (V)<br>(A)<br>(f) | VARIABLE<br>INCREASE:<br>VARIABLE<br>DECREASE: | RAPID PHOTON BLOCKADE INFILL &<br>CAPACITY TO TRIGGER PHASE<br>CHANGE(S)<br>ENHANCE PARTICLE CORE ELECTRON<br>CLOUD REPLUSION; INNER<br>DELAMINATION | VOLT AMP FREQUENCY<br>METERS; TO BE<br>INTEGRATED INTO<br>PROGRAMMABLE APP                 |

FIG. 4D

#### ELEMENT FIVE. Chemotactic sulfidic-bridge-tether-effect (SBTE)

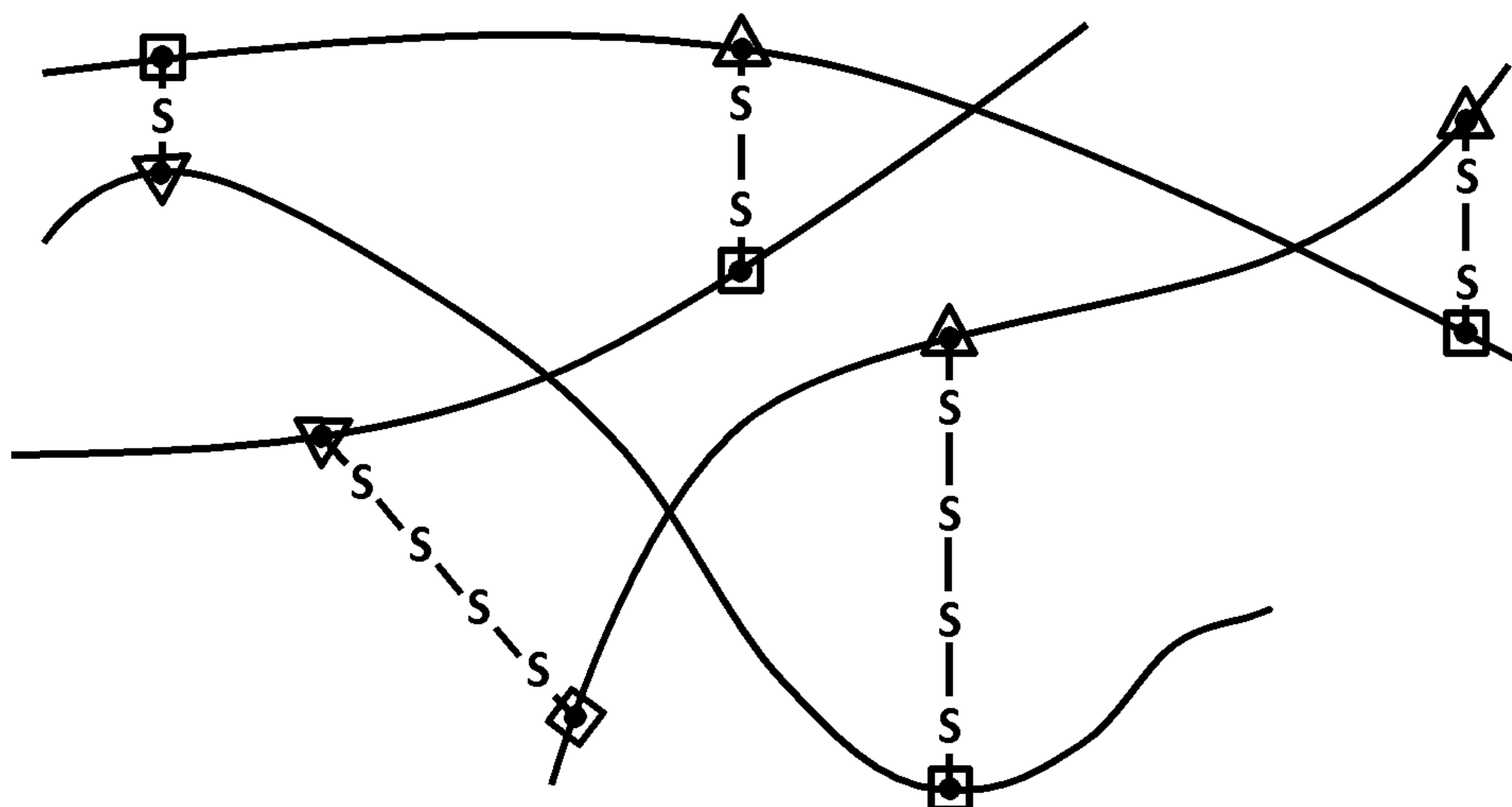


FIG. 5A

-  Pendant vulcanizate precursor @ predominant methyl carbocation (originally forms @ ~140°C)
-  Completed vulcanization @ allylic carbocation (subsequently forms @ ~160°C)

## CARBOCATION STABILITY

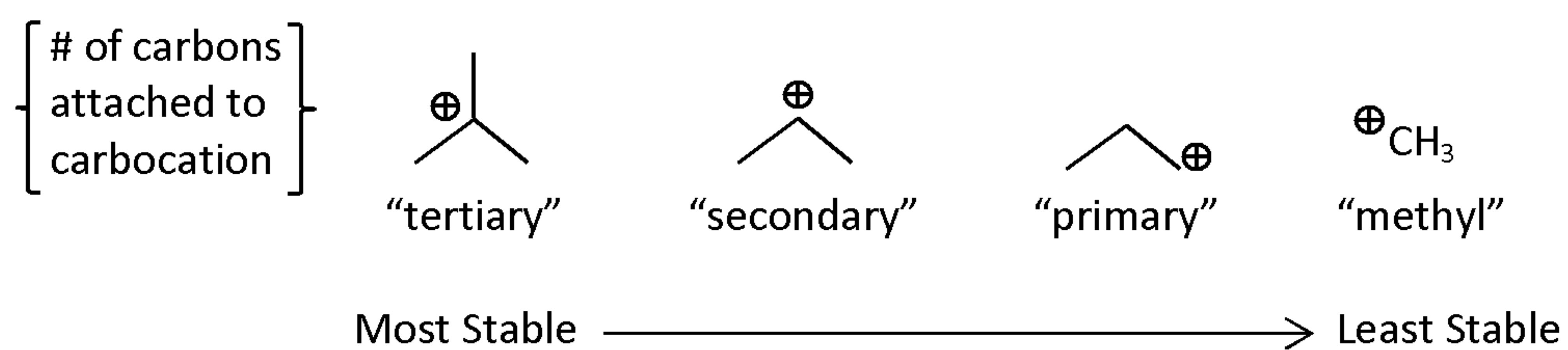


FIG. 5B

ELEMENT SIX: Chemical Reaction Products and Timeline

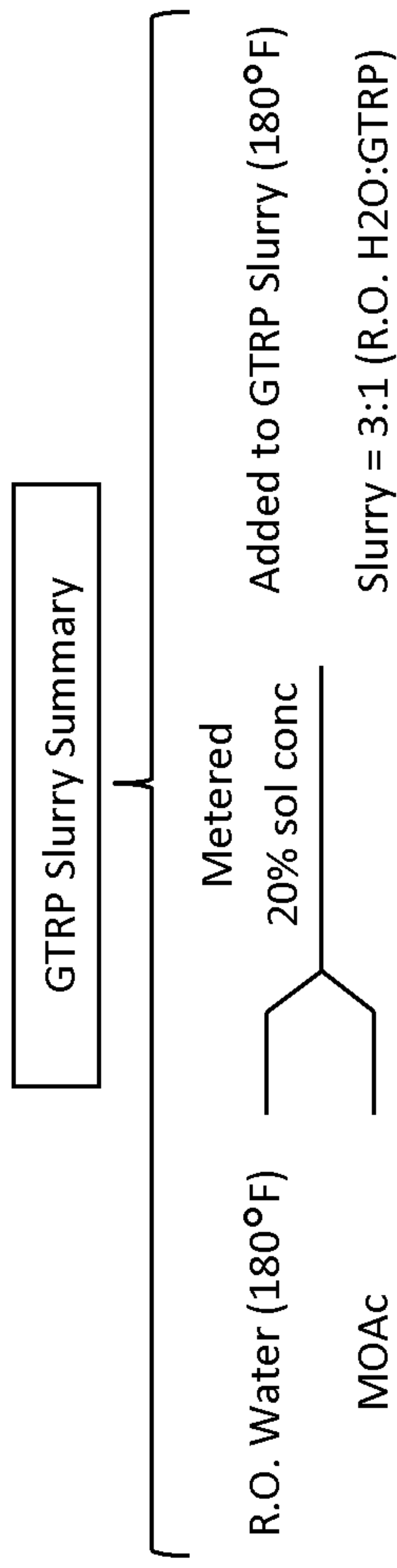


FIG. 6A

Organometallic compound dissolved in water develops ligands, including transient, aquo metal formations.

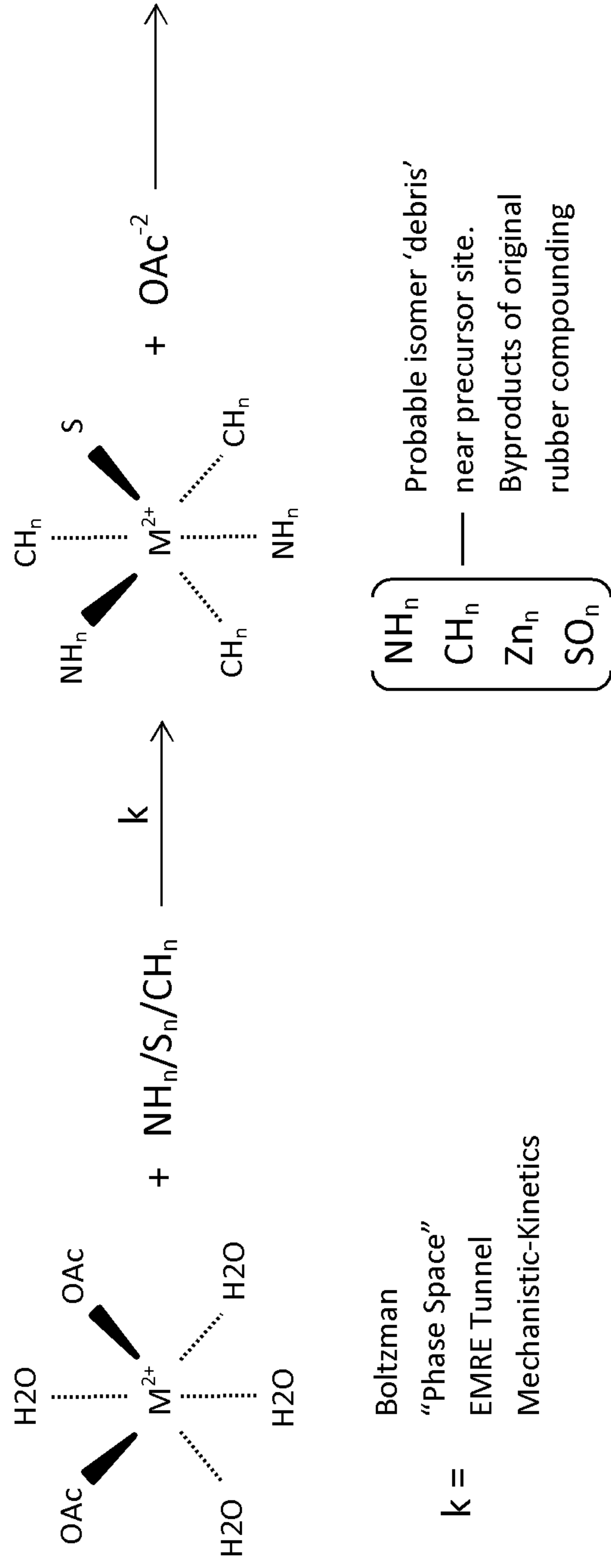


FIG. 6B

- Metal-Acetate Ion  
Dissociative Substitution  
@ methyl carbocation/  
1. disrupts vulcanization precursor  
2. insertion forms new functional site at elastomer pendent structure for subsequent sulfidic bridge realignment  
3.  $\text{O}_2^+ \rightarrow \text{CO}_2$  with "Phase Space" particle charged carbon aggregate  
4. strong  $\text{M}^{2+} - \text{S}^{-2}$  interaction forms a precipitate  
5. liberates rigid sulfidic bridge to 'tether' state bound only at original allylic carbocation

ELEMENT 7: Fabricate Monolithic, Rubber Macro-Structure

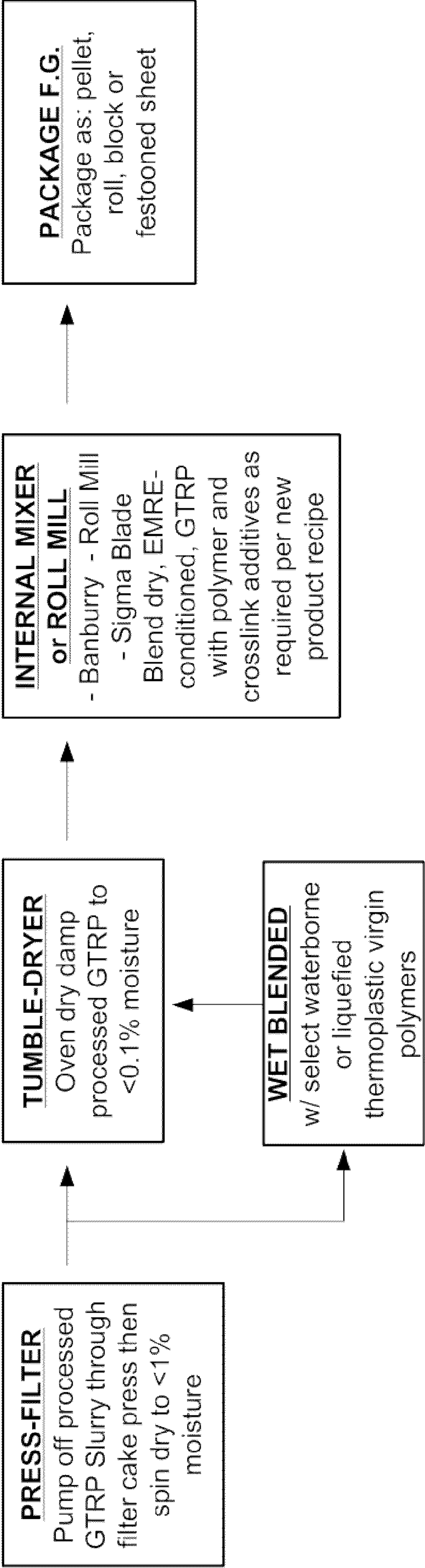


FIG. 7A

STAGE 1: Ground State Vulcanized GTRP      STAGE 2: EMRE-Conditioned GTRP      STAGE 3: Regenerated Interpenetrating Elastomer Network

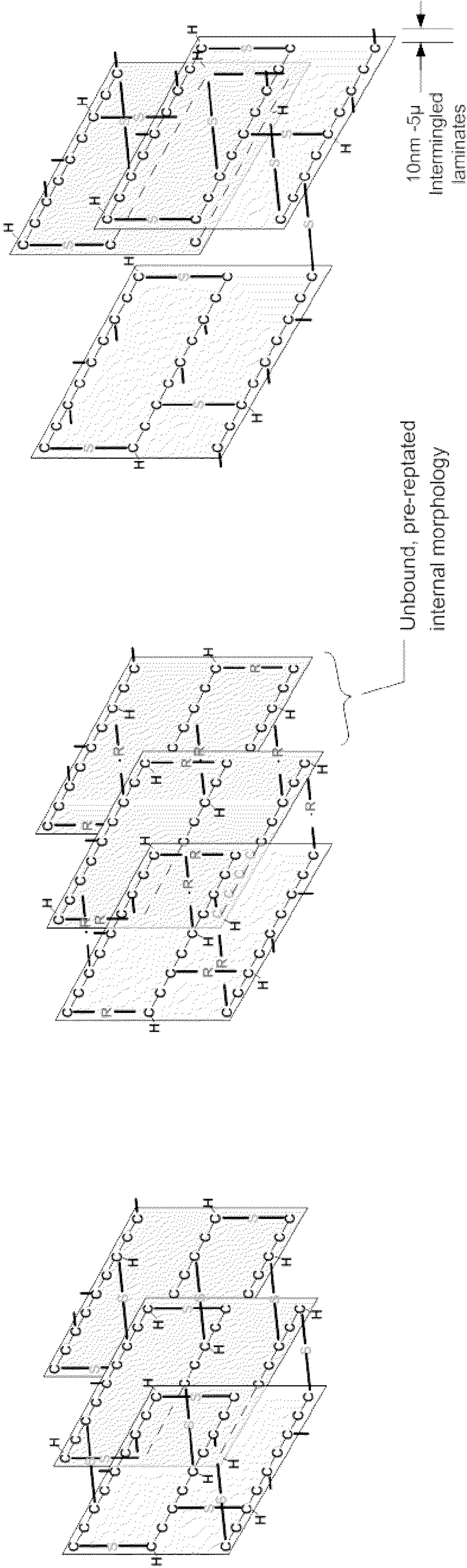


FIG. 7B

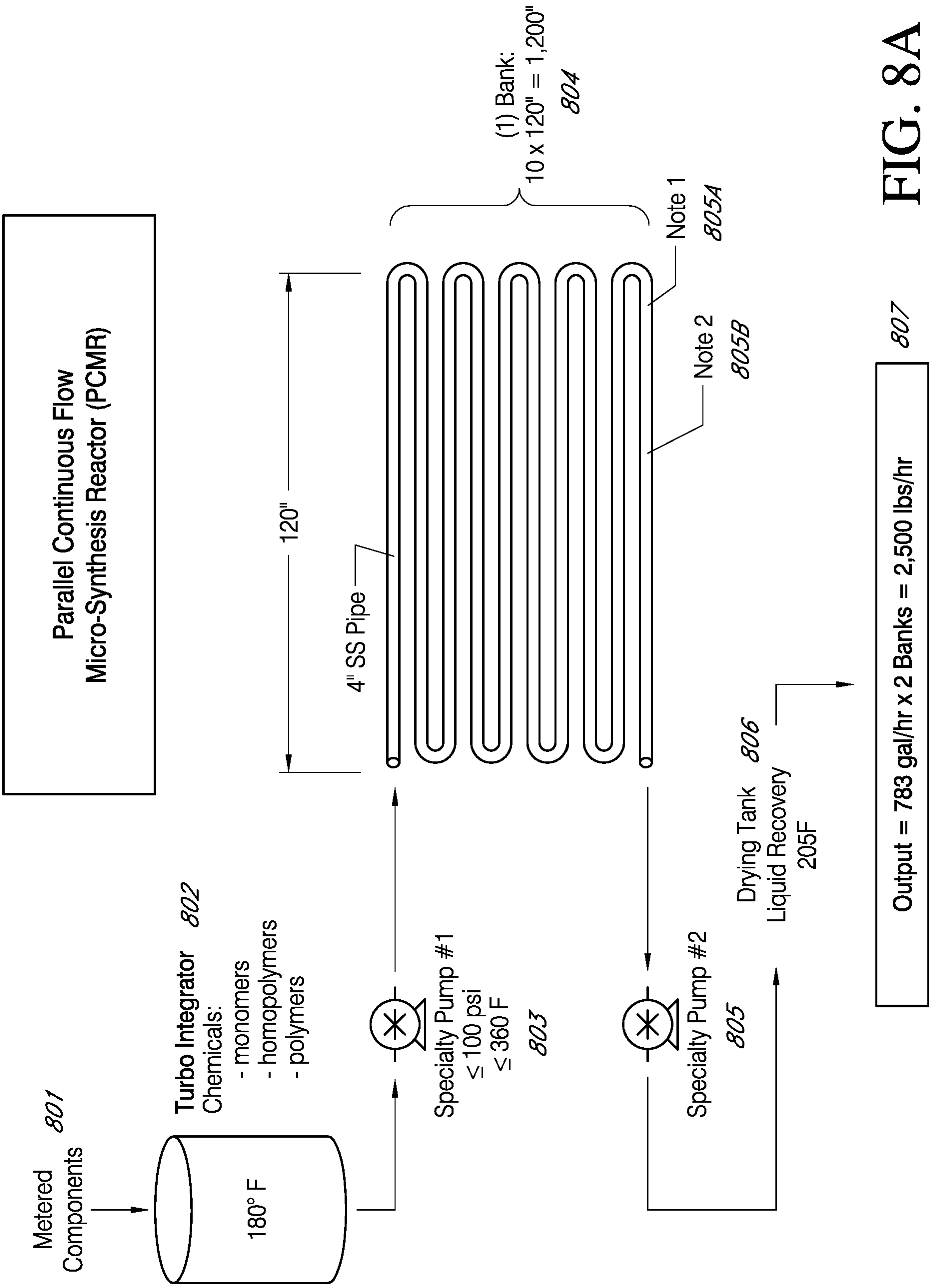


FIG. 8A

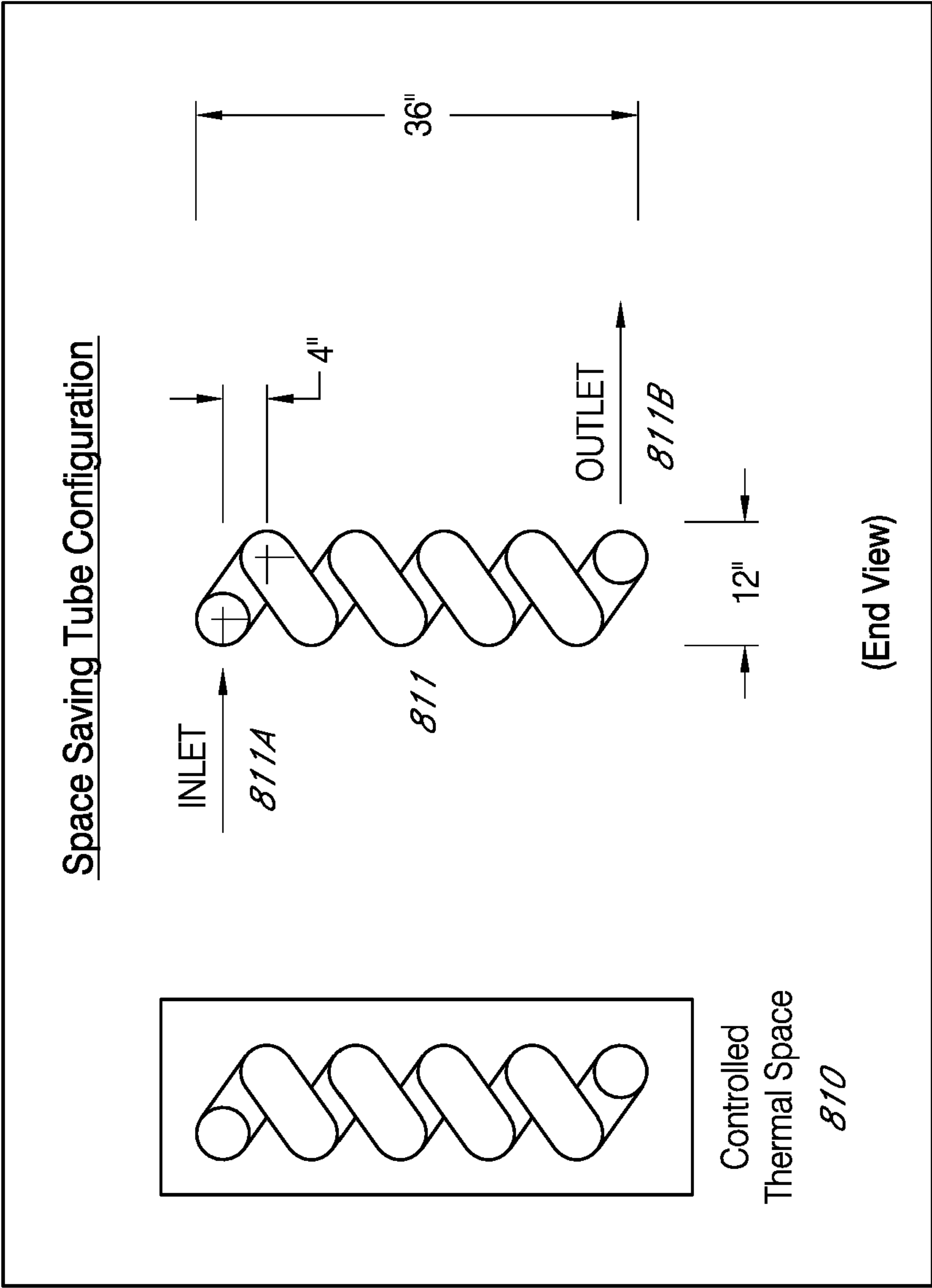


FIG. 8B

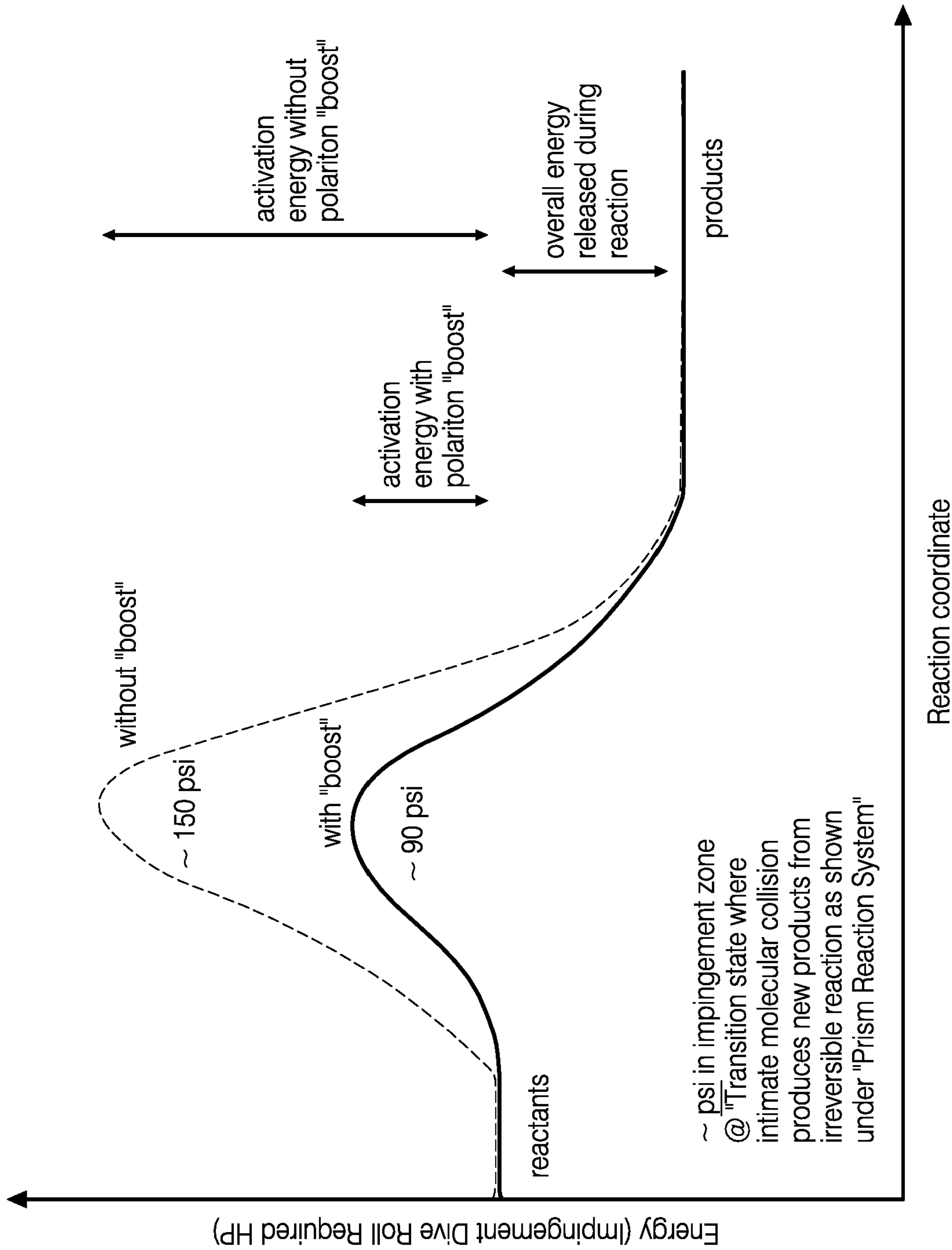


FIG. 9

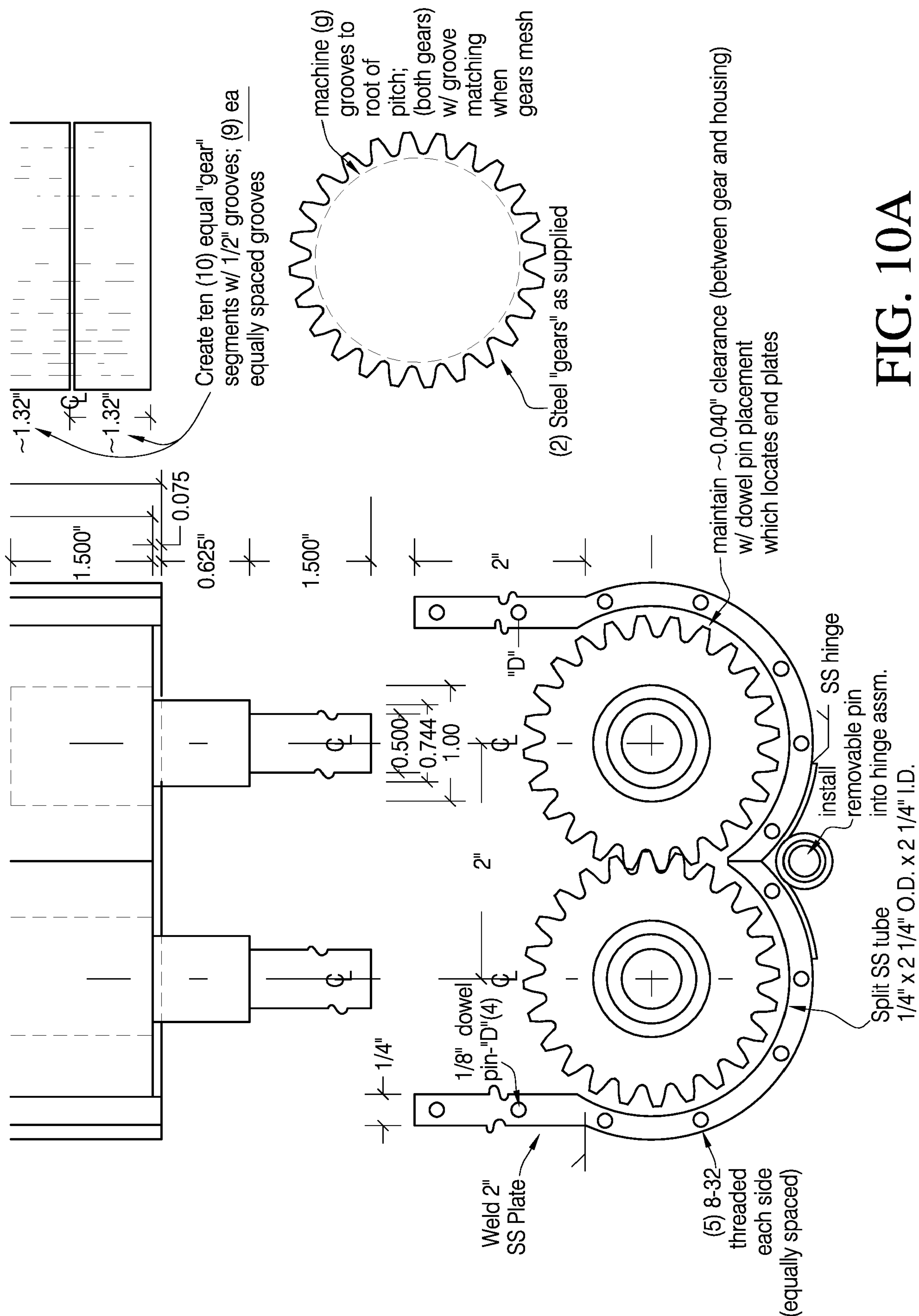


FIG. 10A

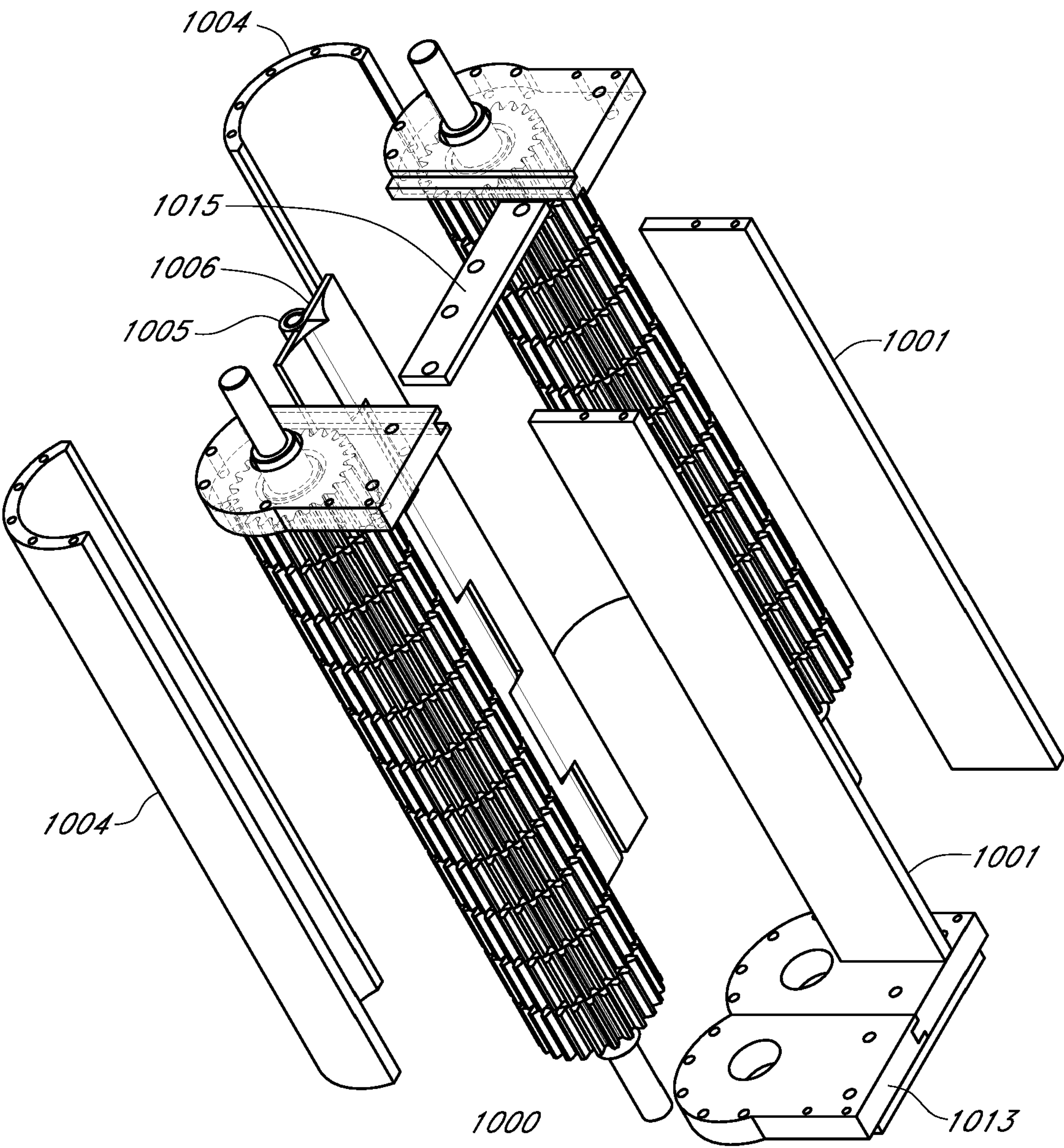


FIG. 10B

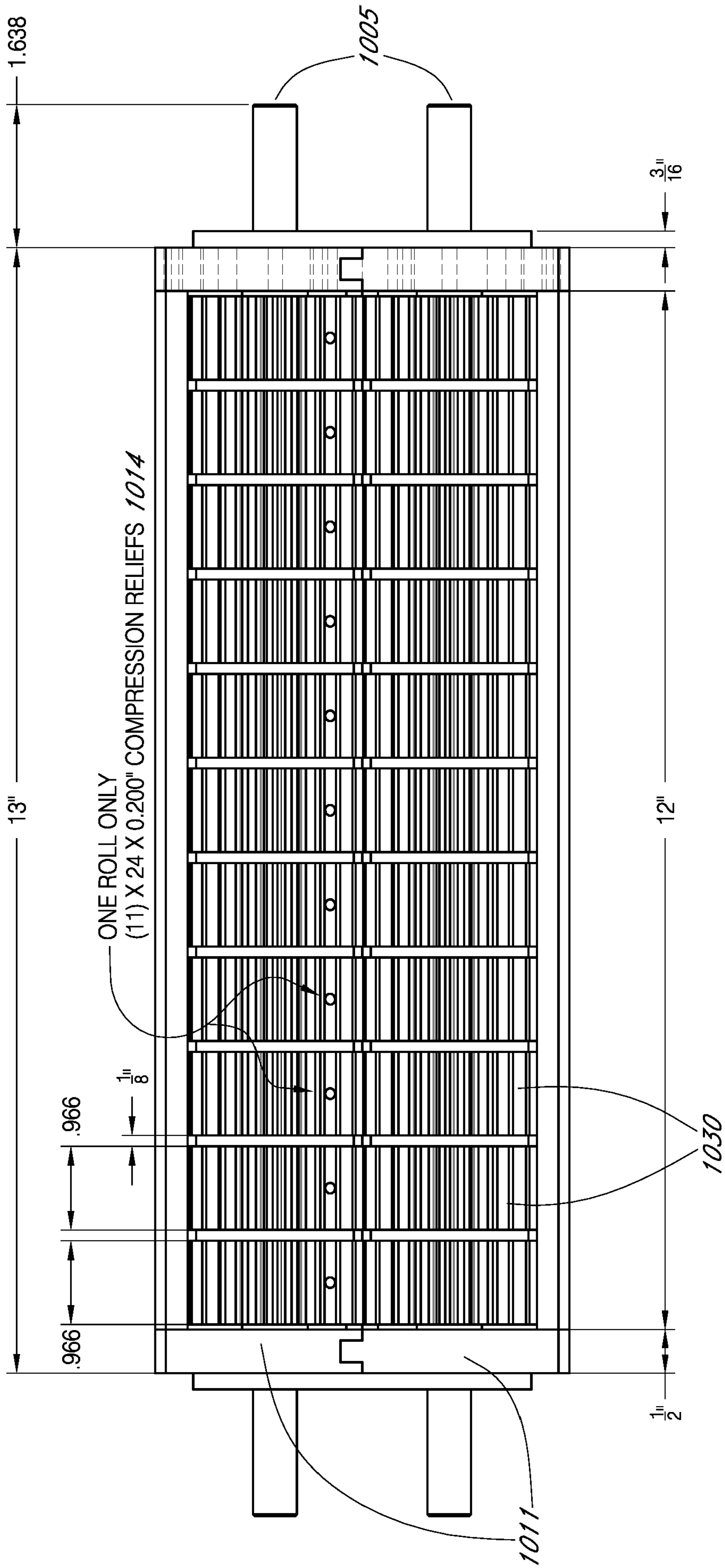


FIG. 10C

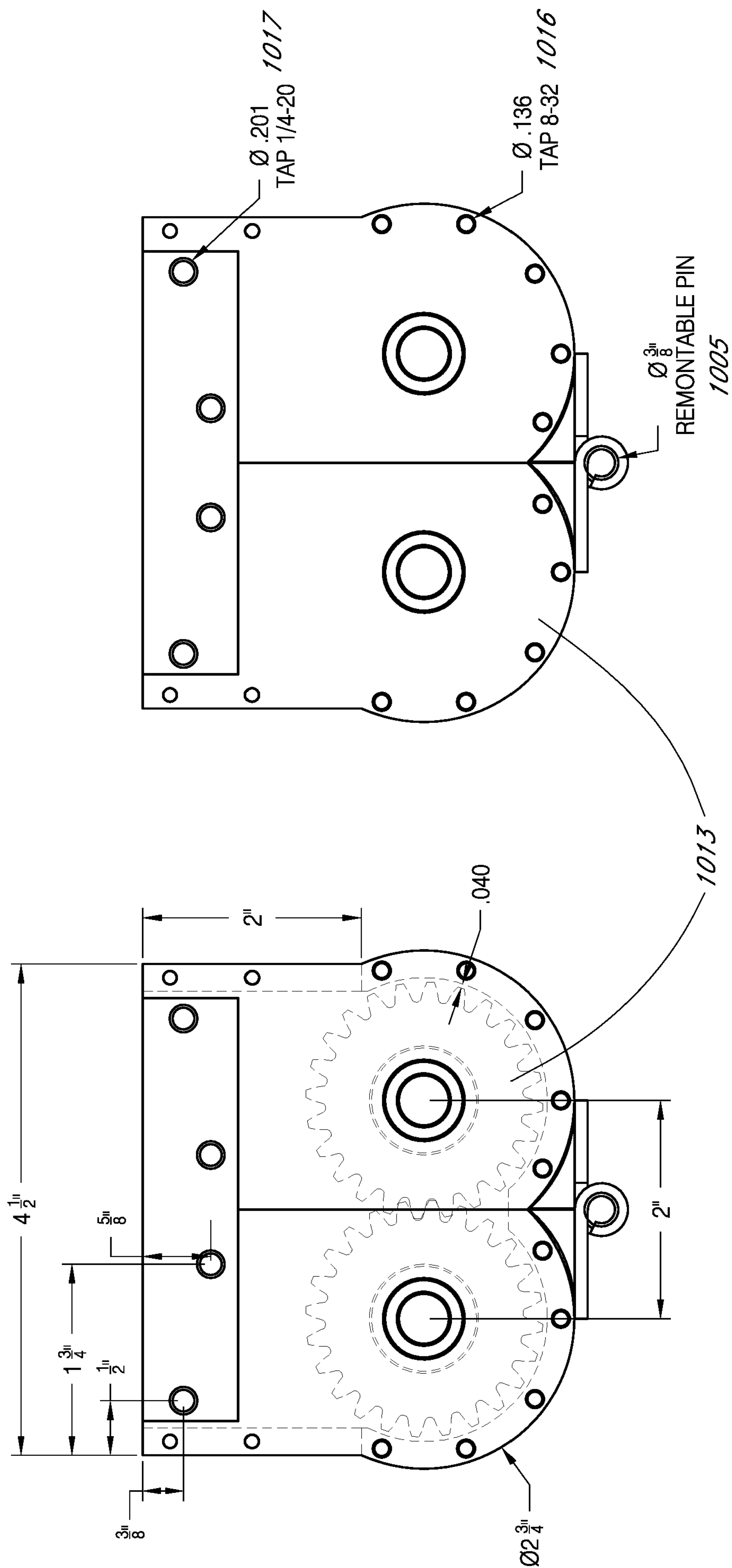


FIG. 10D

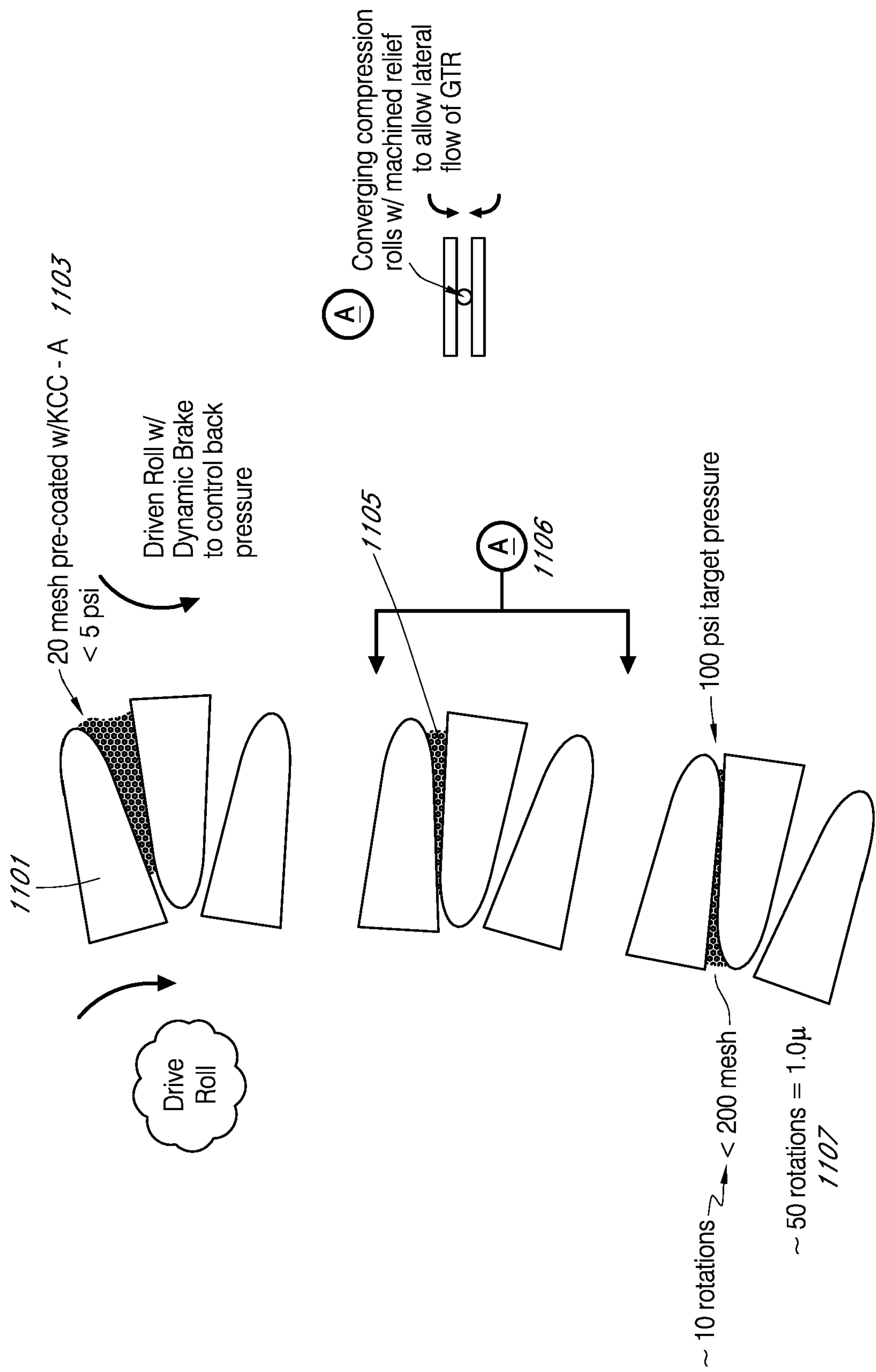


FIG. 11

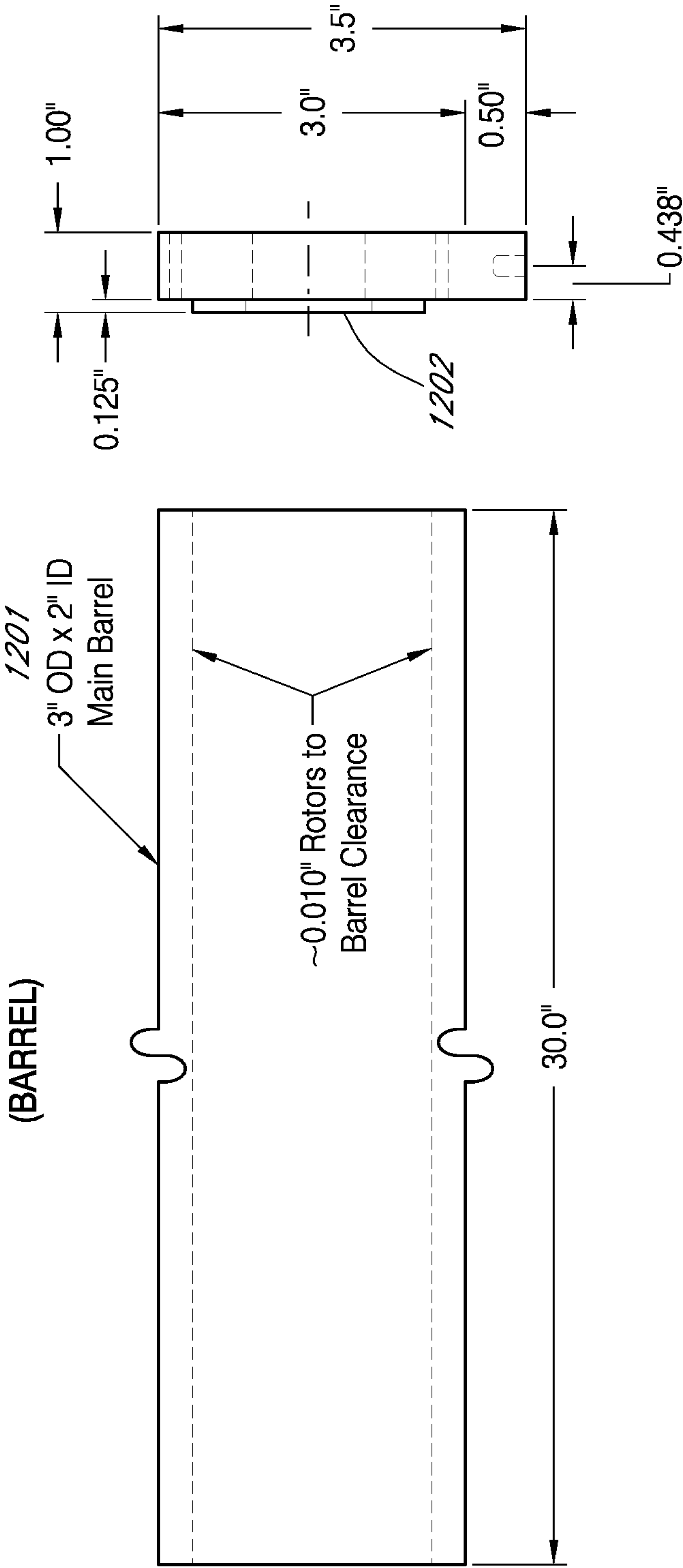


FIG. 12A

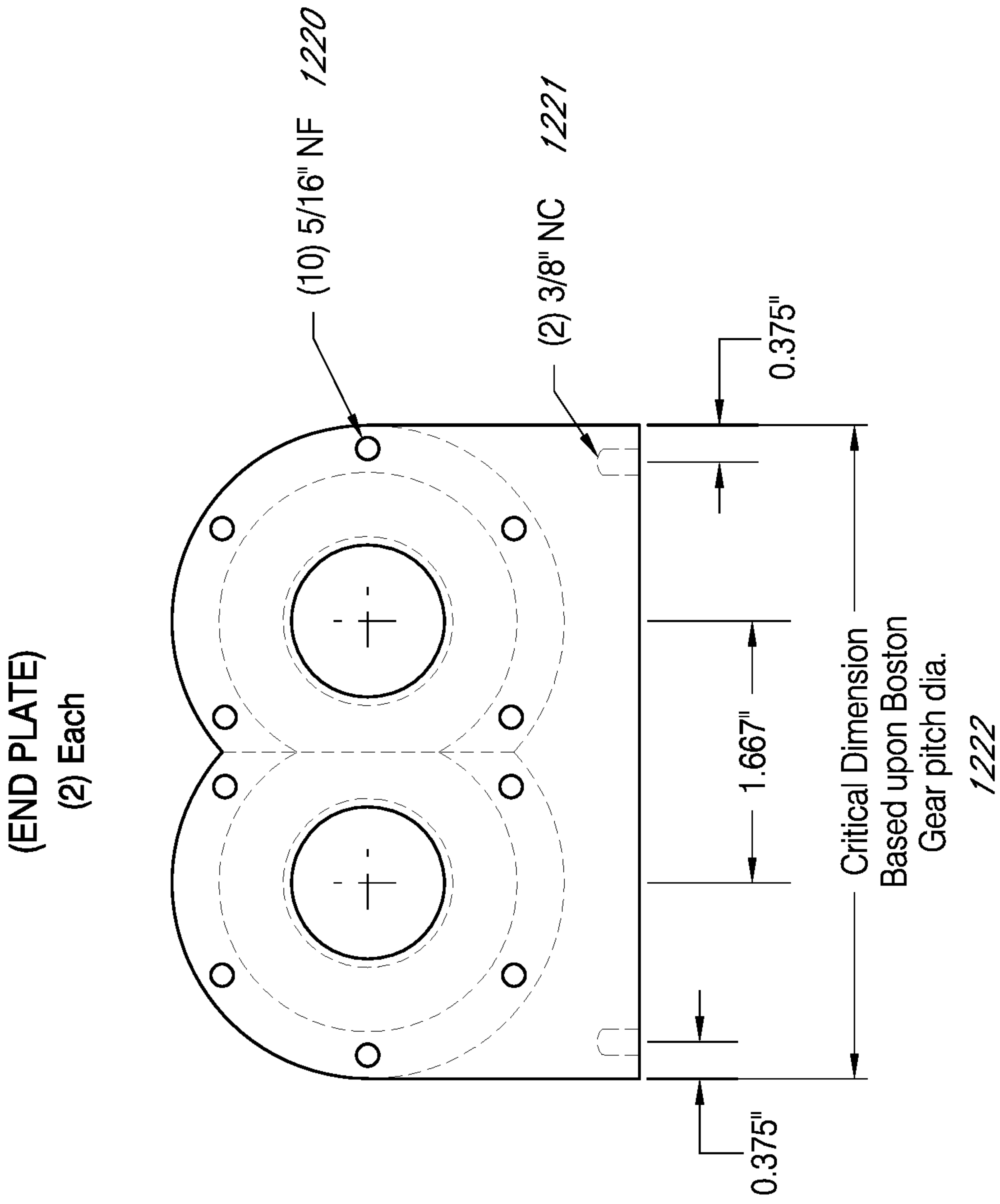
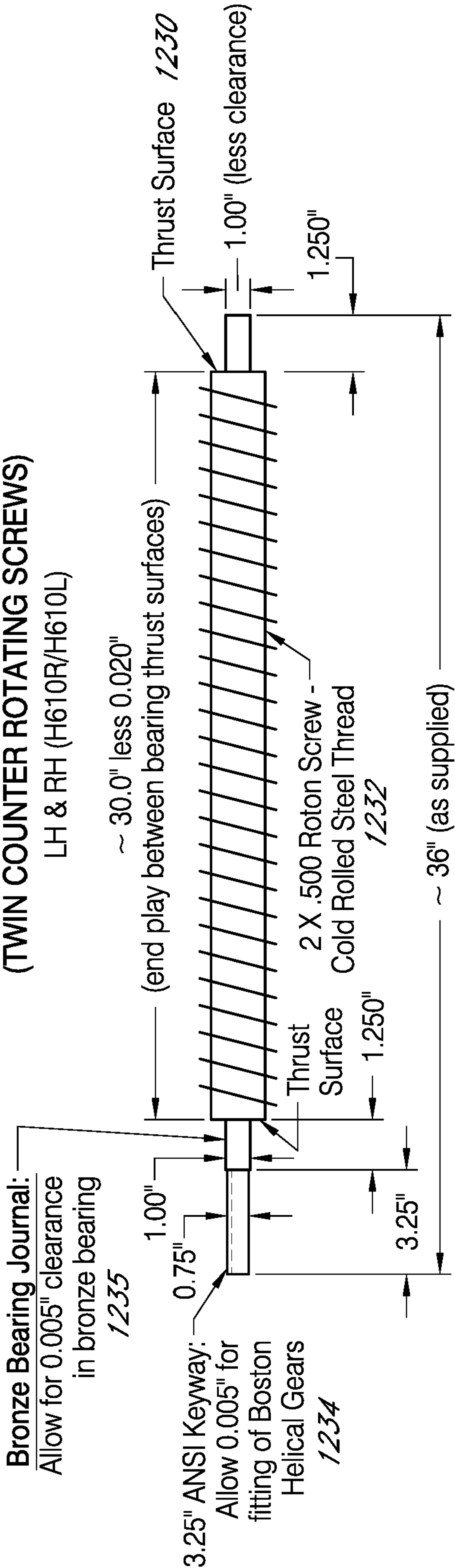


FIG. 12B



Notes:

1. Final screw close-intermesh to be timed w/ key placement on one shaft
2. Screw pitch diameter(s) machined (touch-up) for crown to trough clearance.

FIG. 12C

## SAN JOAQUIN REFINING CO., INC

CERTIFICATE OF ANALYSIS  
LABORATORY REPORT - ASPHALT PRODUCTS

Performance Graded Asphalt Binder per CALTRANS Specification

PRODUCT: PAVING ASPHALT PG 64-10 PRODUCT: 2185  
AASHTO SPECIFICATION GRADE

| PROPERTY                                                                                                | Test Method | PG 64-10<br>SPEC  | PG 64-10<br>TEST    |
|---------------------------------------------------------------------------------------------------------|-------------|-------------------|---------------------|
| <b>ORIGINAL BINDER</b>                                                                                  |             |                   |                     |
| Flash Point, Minimum C                                                                                  | T-48        | 230               | 296                 |
| VOC's, %                                                                                                | ASTM D402   | <0.5%v            | 0.0                 |
| Solubility, Minimum %                                                                                   | T-44        | 99                | 99.8                |
| Viscosity at 135 C,<br>Maximum, Pa's                                                                    | T-316       | 3.0               | 0.256               |
| Dynamic Shear,<br>Test Temp. at 10 rad/s, C<br>Minimum G*/sin(delta), kPa<br>Phase Angle, $\delta$ (*)  | T-315       | 64<br>1.00        | 64<br>1.406<br>89.5 |
| <b>RTFO Test Aged Binder</b>                                                                            |             |                   |                     |
| RTFO Test<br>Mass Loss, Maximum, %                                                                      | T-240       | 1.00              | -0.214              |
| Dynamic Shear,<br>Test Temp. at 10 rad/s, C<br>Minimum G*/sin(delta), kPa<br>Phase Angle, $\delta$ (*)  | T-315       | 64<br>2.2         | 64<br>2.399<br>88.6 |
| Ductility at 25 C<br>Minimum, cm                                                                        | T-51        | 75                | 150                 |
| PAV Aging,<br>Temperature, C                                                                            | R-28        | 100               | 100                 |
| <b>RTFO Test and PAV Aged Binder</b>                                                                    |             |                   |                     |
| Dynamic Shear,<br>Test Temp. at 10 rad/s, C<br>Maximum, G*/sin(delta), kPa<br>Phase Angle, $\delta$ (*) | T-315       | 31<br>5000        | 31<br>3440<br>66.5  |
| Bending Beam, Creep Stiffness,<br>Test Temperature, C<br>Maximum S-value, Mpa<br>Minimum M-value        | T-313       | 0<br>300<br>0.300 | 0<br>138<br>0.468   |

Tank No.: 20004 Carrier: \_\_\_\_\_ Quantity: (Gal) \_\_\_\_\_ (Tons) \_\_\_\_\_  
 Batch No.: 170523 Truck No.: API Gravity @ 60F: 6.3 Specific Gravity @ 60 F: 1.0268  
 Buyer: \_\_\_\_\_ Loading Temp, F: \_\_\_\_\_ Shipment Date: \_\_\_\_\_

We hereby certify that the above determinations were performed in accordance with AASHTO, ASTM or other applicable test methods and that the product designated hereon conforms to the Caltrans specification for the product indicated: PG 64-10

DATE: 5/23/2017

TESTER:

Don Conner

FIG. 13

|                                    | AASHTO<br>Test Method | SJR<br>PG 64-10 Base | PTR<br>PG 64-10 |       | Specification |
|------------------------------------|-----------------------|----------------------|-----------------|-------|---------------|
| Specific Gravity, 60°F (15.6°C)    | T228                  | 1.026                | 1.022           |       | Report        |
| Rotational Viscosity, 135°C Pa*s   | T316                  | 0.244                | 0.378           |       | 3.0 Max.      |
| Flash, COC, °C                     | T48                   | 294                  | 290             |       | 230 Min.      |
| Solubility in Trichloroethylene, % | T44                   | 99.9                 | 99.2            |       | 99.0 Min.     |
| Dynamic Shear Rheometer, °C        | T315                  | 64                   | 58              | 64    |               |
| G*, kPa                            |                       | 1.38                 | 1.44            | 0.75  |               |
| Phase Angle, $\delta$ , °          |                       | 89.6                 | 74.4            | 71.0  |               |
| G*/Sin $\delta$ , kPa              |                       | 1.38                 | 1.50            | 0.79  | 1.00-2.00     |
| Pass/Fail Temperature, °C          |                       | -                    | 61.8            |       |               |
| RTFO-Aged                          | T240                  |                      |                 |       |               |
| Mass Loss, w%                      | T240                  | 0.196                | 0.254           |       | 1.0 Max.      |
| Dynamic Shear Rheometer, °C        | T315                  | 64                   | 58              | 64    |               |
| G*, kPa                            |                       | 2.22                 | 2.26            | 1.02  |               |
| Phase Angle, $\delta$ , °          |                       | 89.0                 | 79.3            | 79.8  |               |
| G*/Sin $\delta$ , kPa              |                       | 2.22                 | 2.30            | 1.04  | 2.20 Min.     |
| Pass/Fail Temperature, °C          |                       | -                    | 58.5            |       |               |
| Ductility, 25°C, cm                | T51                   | 150+                 | 150+            |       | 75 Min.       |
| Elastic Recovery, 25°C, %          | T301                  | -                    | 65.0            |       | 75.0 Min.     |
| PAV-Aged, °C                       | R28                   | 100                  | 100             |       |               |
| Dynamic Shear Rheometer, °C        | T315                  | 31                   | 22              | 19    |               |
| G*, kPa                            |                       | 4492                 | 3974            | 6994  |               |
| Phase Angle, $\delta$ , °          |                       | 65.9                 | 62.8            | 58.7  |               |
| G*Sin $\delta$ , kPa               |                       | 4100                 | 3535            | 5976  | 5000 Max.     |
| Pass/Fail Temperature, °C          |                       | -                    | 20.0            |       |               |
| Bending Beam Rheometer, °C         | T313                  | 0                    | -12             | -18   |               |
| Stiffness, MPa                     |                       | 151                  | 233             | 505   | 300 Max.      |
| Pass/Fail Temperature, °C          |                       | -                    | -13.5           |       |               |
| m-value                            |                       | 0.474                | 0.383           | 0.271 | 0.300 Min.    |
| Pass/Fail Temperature, °C          |                       | -                    | -16.4           |       |               |
| PG Grade                           |                       | -                    | 58-22           |       |               |

FIG. 14A

|                                    | AASHTO<br>Test Method | SJR<br>PG 64-10 Base | PTR<br>PG 64-10 |       |
|------------------------------------|-----------------------|----------------------|-----------------|-------|
| Multiple Stress Creep Recovery, °C | T350                  | 64                   | 58              | 64    |
| Recovery @ 0.1 kPa, %              |                       | -0.068               | 84.59           | 91.29 |
| Recovery @ 3.2 kPa, %              |                       | -1.274               | 35.69           | 19.97 |
| Difference in Recovery, %          |                       | -1782.9              | 57.80           | 78.13 |
| Jnr @ 0.1 kPa, 1/kPa               |                       | 4.689                | 0.542           | 0.577 |
| Jnr @ 3.2 kPa, 1/kPa               |                       | 4.842                | 2.478           | 6.334 |
| Difference in Jnr, %               |                       | 3.256                | 357.5           | 997.9 |

FIG. 14B

|                             | AASHTO<br>Test Method | Prism PG 64-10 |        |
|-----------------------------|-----------------------|----------------|--------|
|                             |                       | Top            | Bottom |
| Dynamic Shear Rheometer, °C | T315                  | 58             | 58     |
| G*, kPa                     |                       | 1.50           | 1.87   |
| Phase Angle, $\delta$ , °   |                       | 74.3           | 75.8   |
| G*/Sin $\delta$ , kPa       |                       | 1.56           | 1.93   |

FIG. 14C

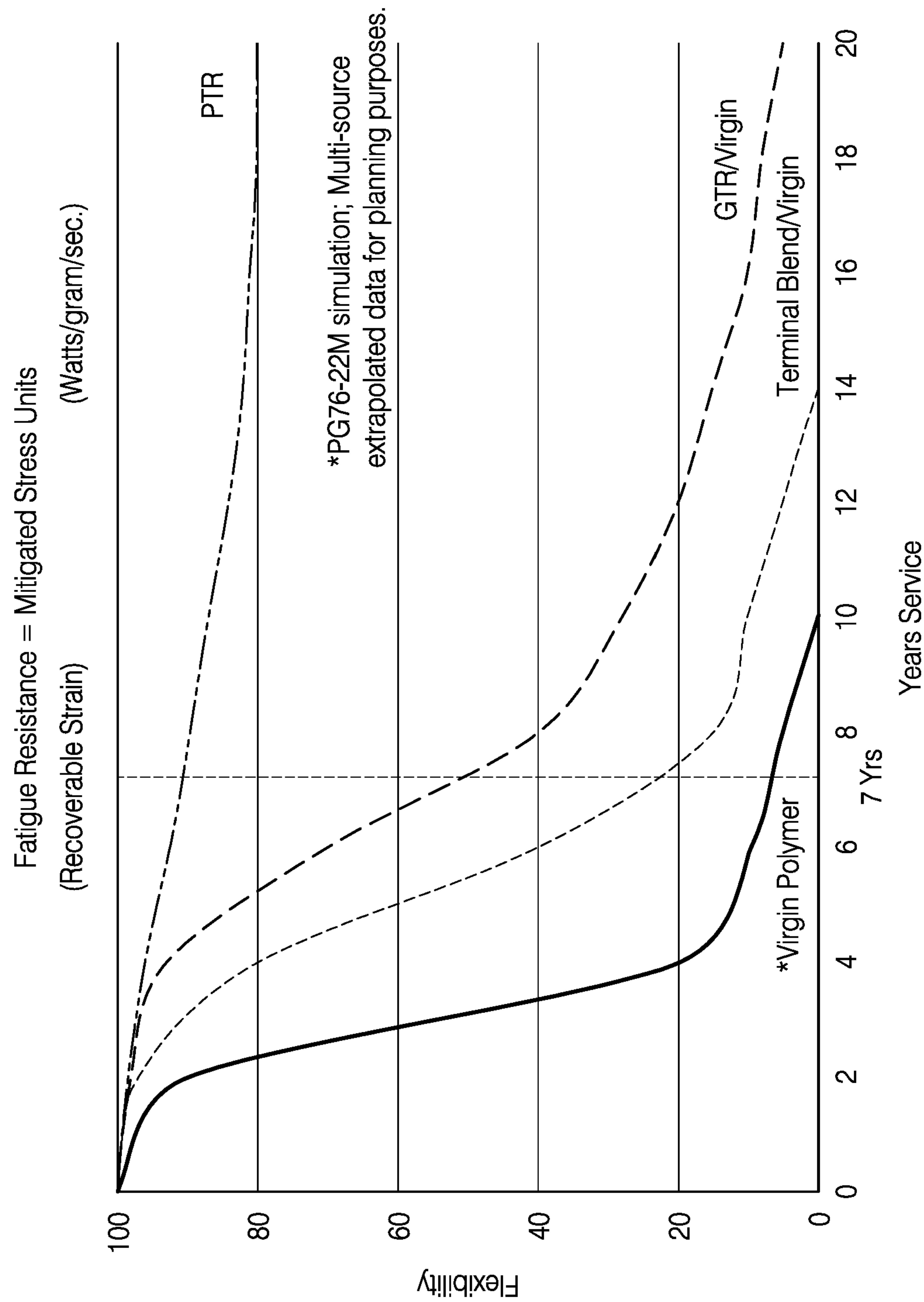


FIG. 15

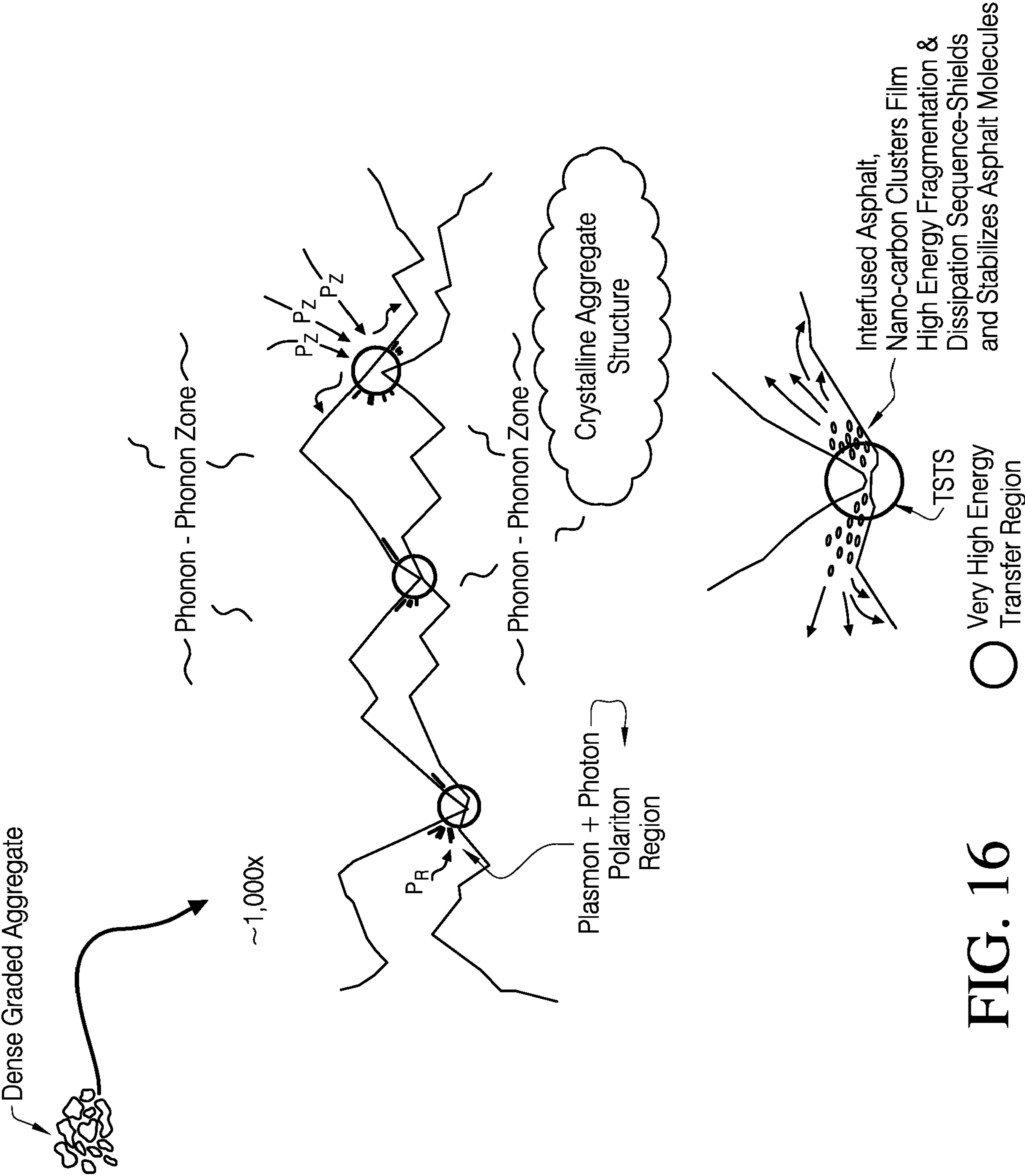


FIG. 16

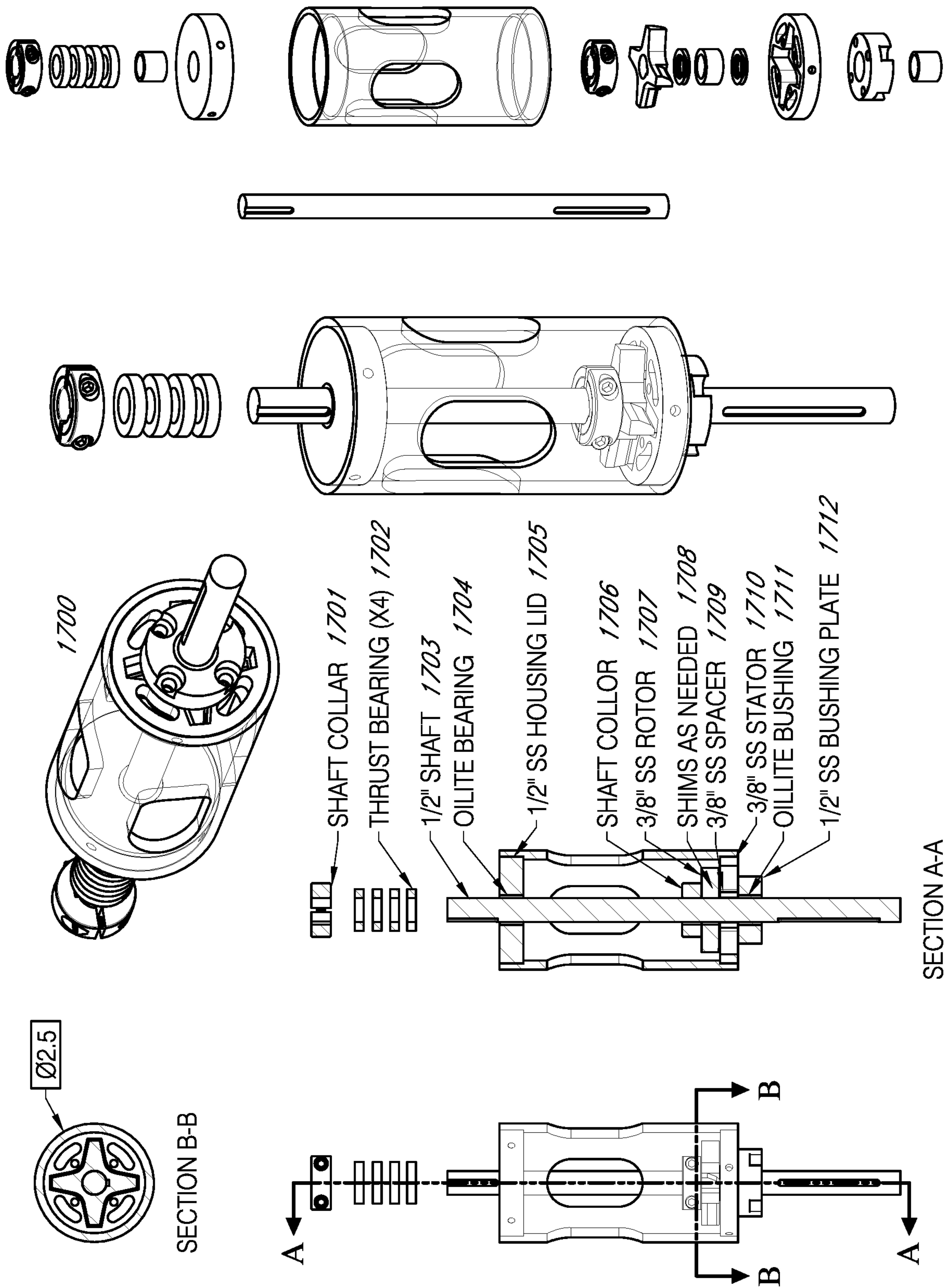


FIG. 17A

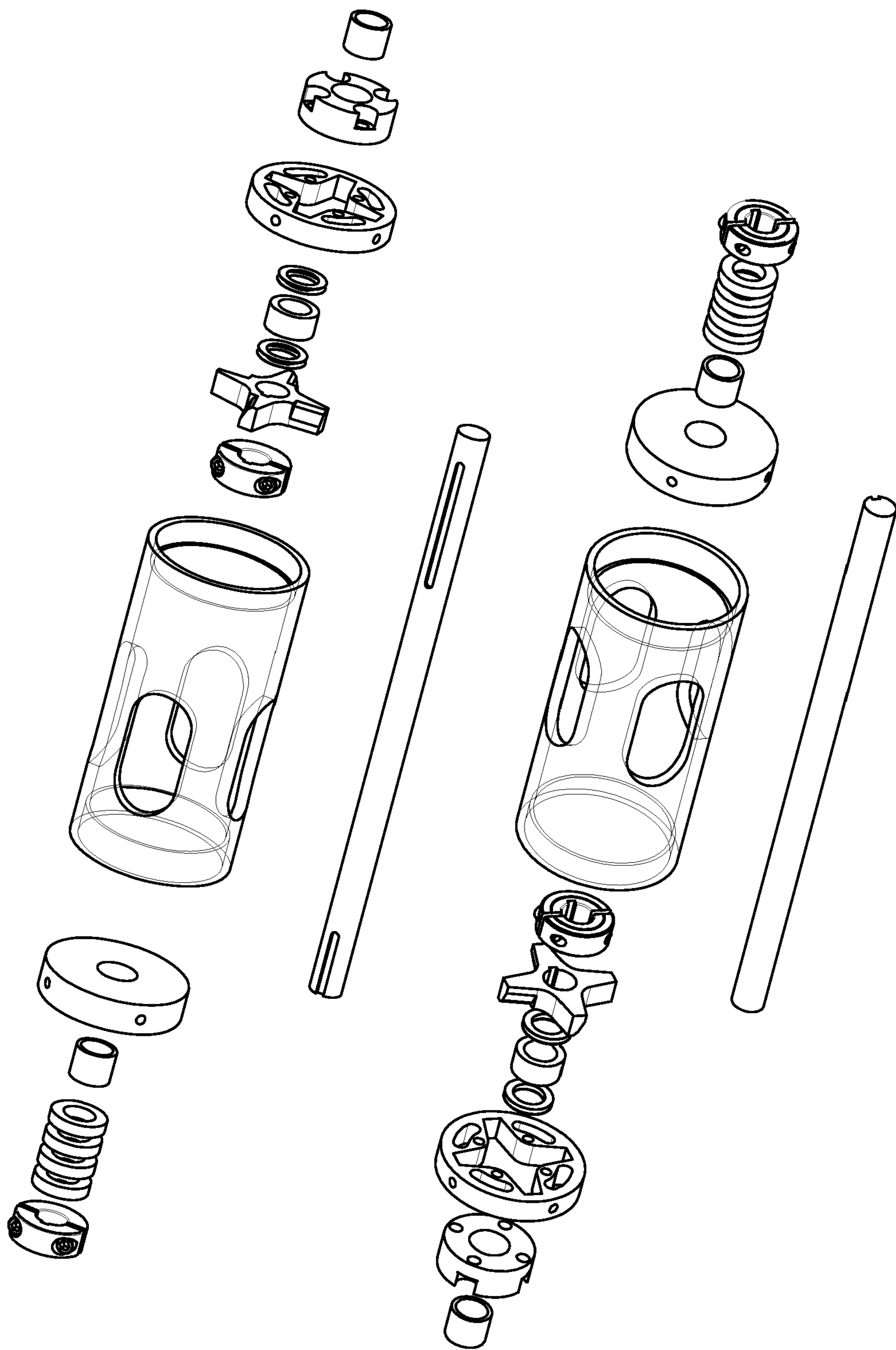


FIG. 17B