FIG. 1

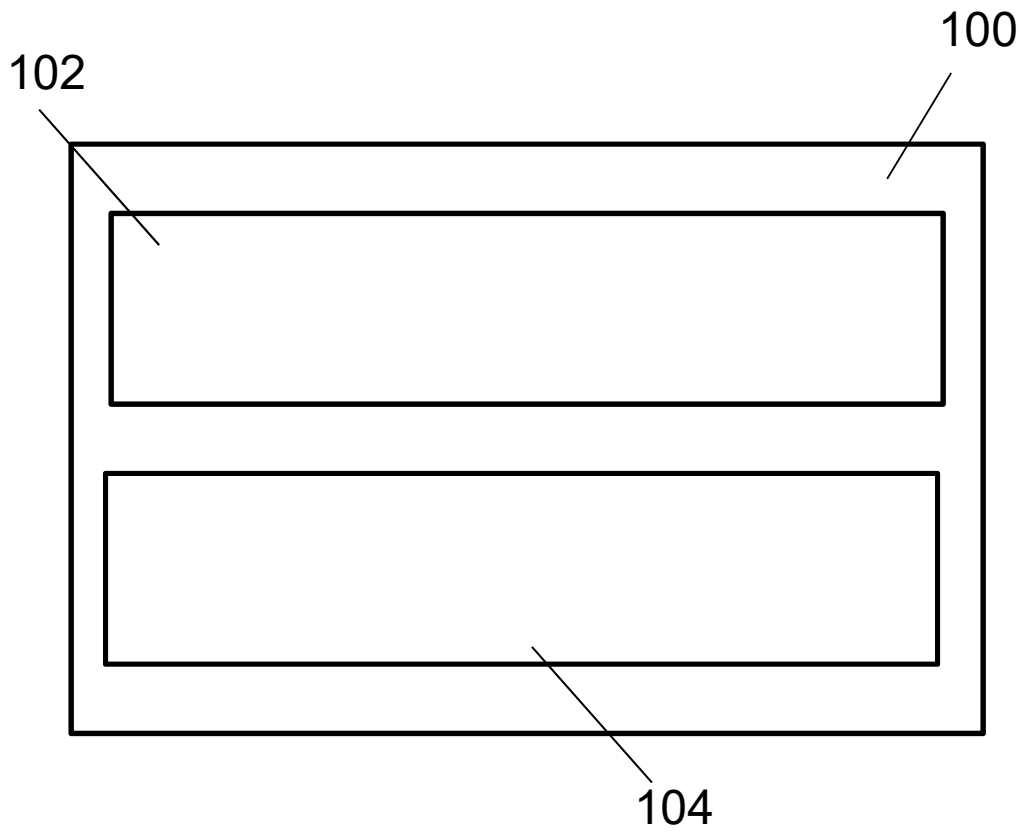


FIG. 2

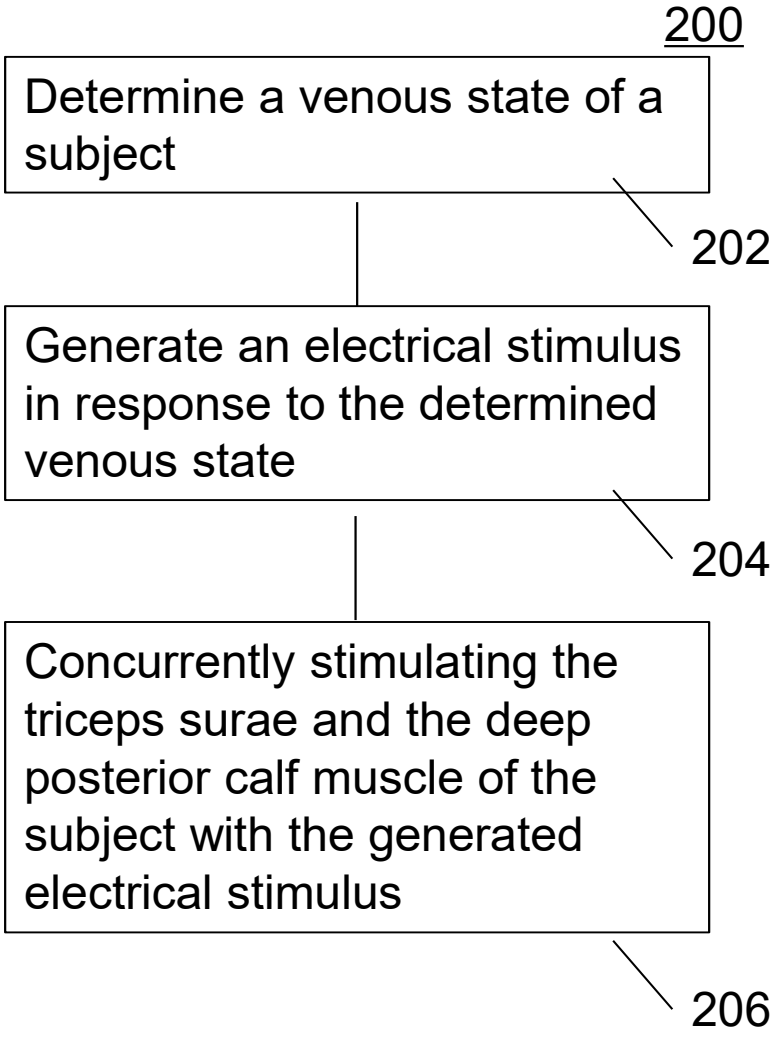

200
Determine a venous state of a subject
202
Generate an electrical stimulus in response to the determined venous state
204
Concurrently stimulating the triceps surae and the deep posterior calf muscle of the subject with the generated electrical stimulus
206

FIG. 3

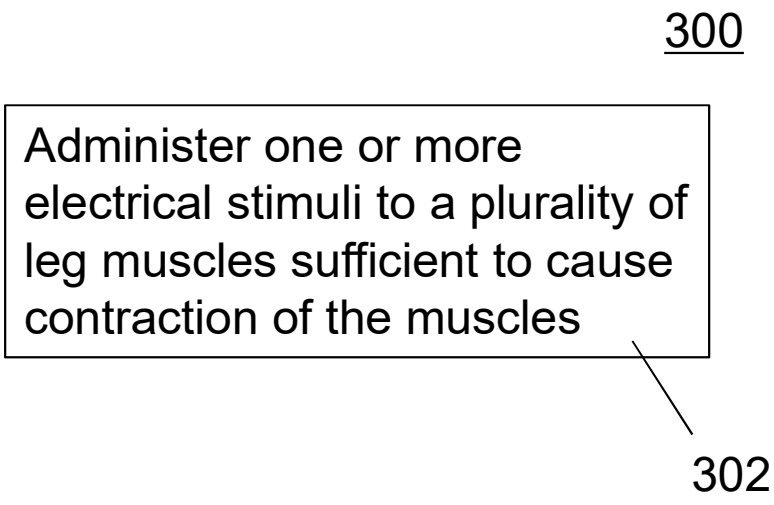

300
Administer one or more electrical stimuli to a plurality of leg muscles sufficient to cause contraction of the muscles
302

FIG. 4

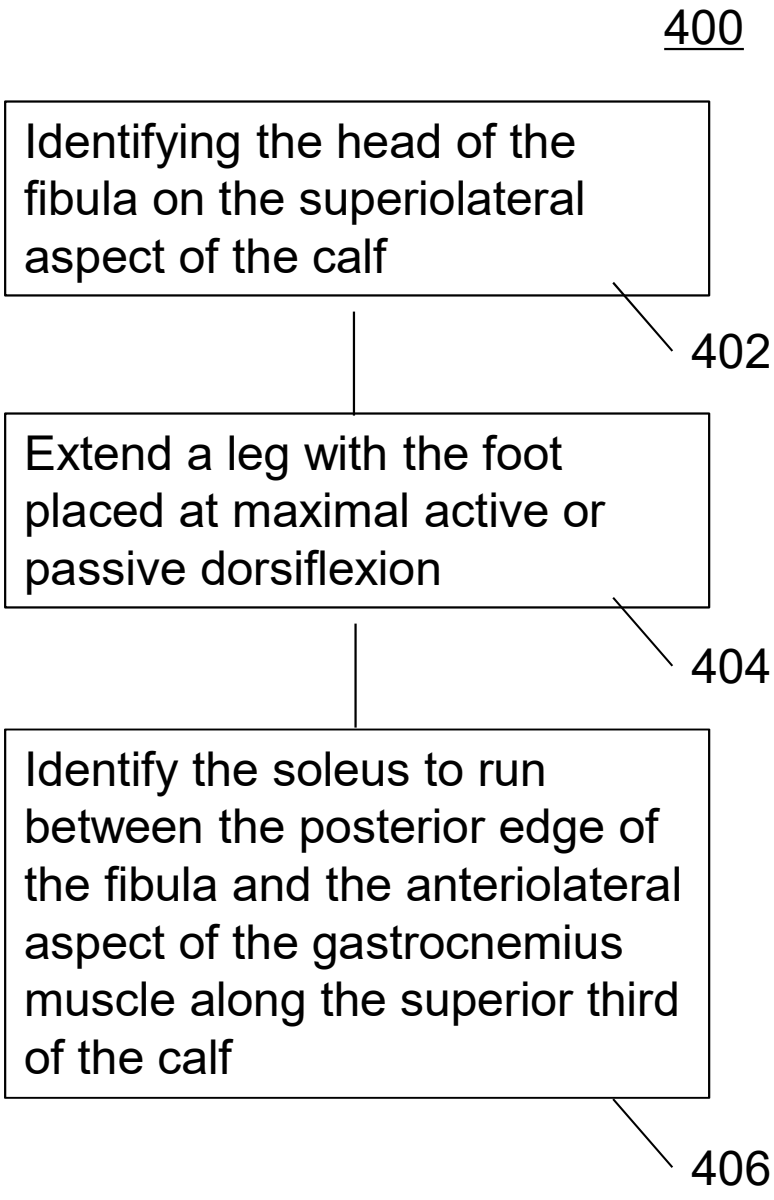

400
Identifying the head of the fibula on the superiolateral aspect of the calf
402
Extend a leg with the foot placed at maximal active or passive dorsiflexion
404
Identify the soleus to run between the posterior edge of the fibula and the anteriolateral aspect of the gastrocnemius muscle along the superior third of the calf
406

FIG. 5

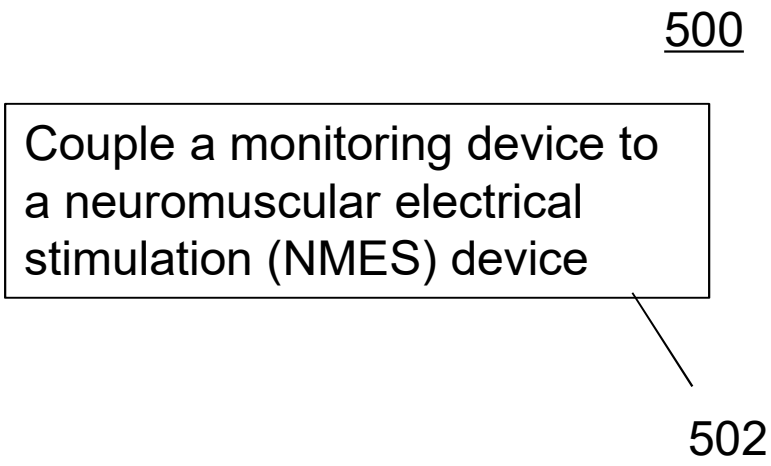

500
Couple a monitoring device to a neuromuscular electrical stimulation (NMES) device
502

FIG. 6A

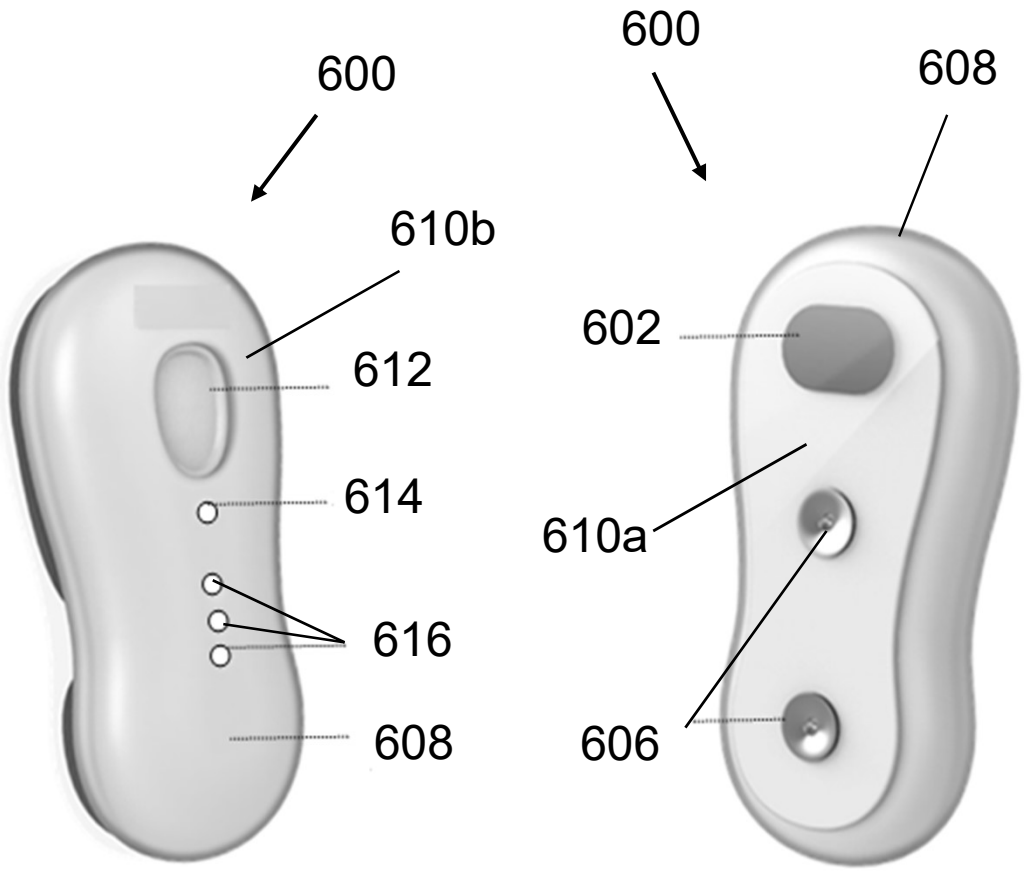


FIG. 6B

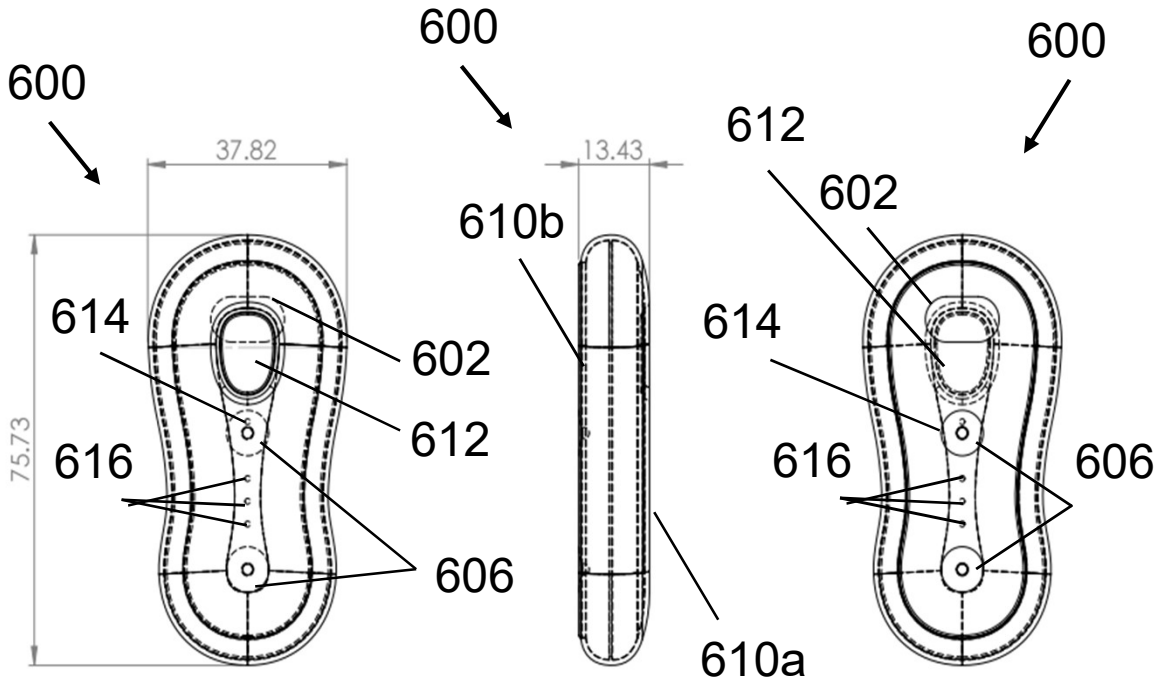

600
600
600
37.82
13.43
75.73
614
602
612
616
606
610b
610a
612
602
614
616
606

FIG. 6C

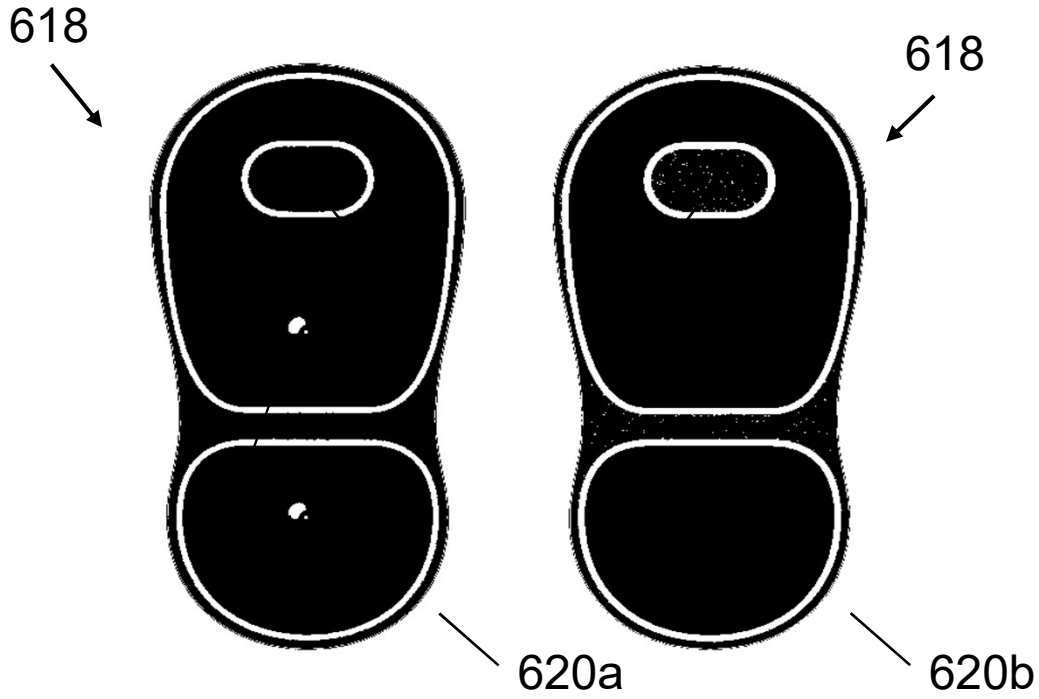

618
618
620a
620b

FIG. 6D

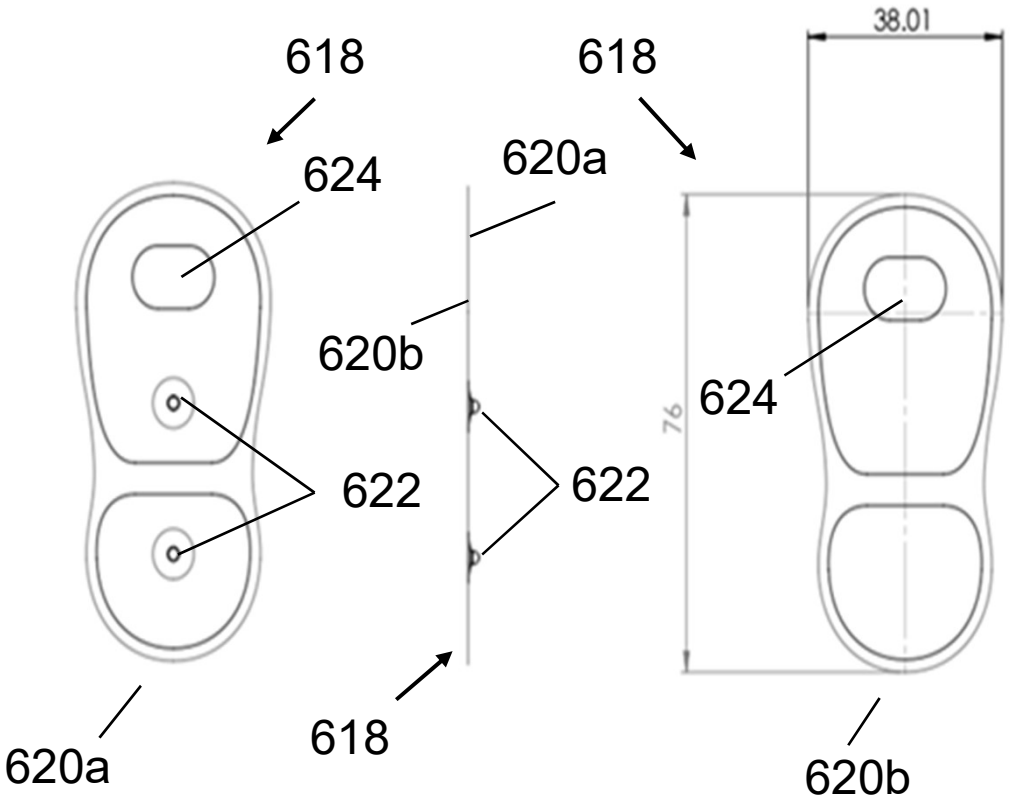

38.01
618
618
624
620a
620b
624
76
622
622
620a
618
620b

FIG. 6E

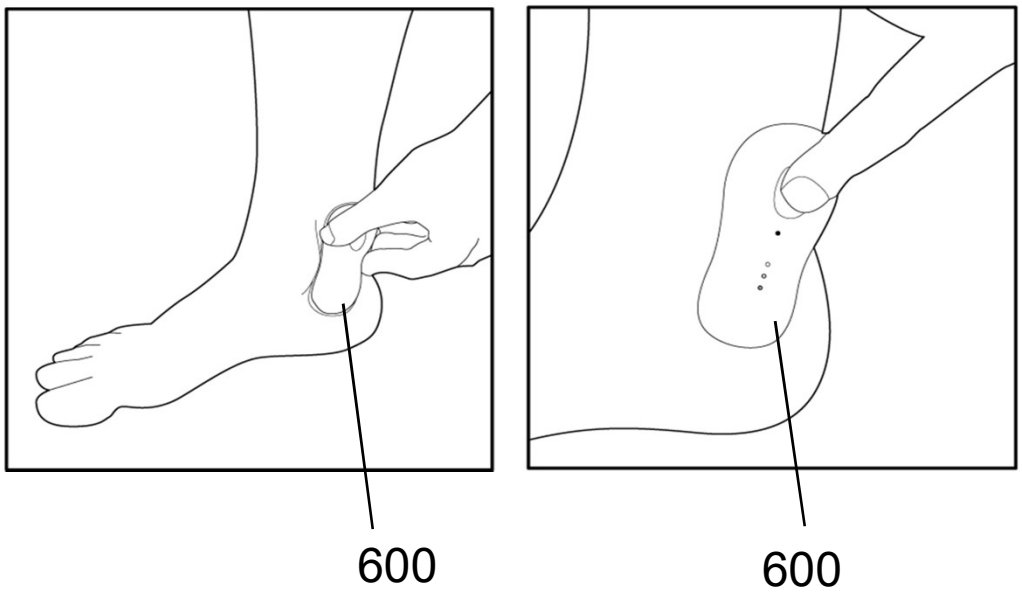


FIG. 7A

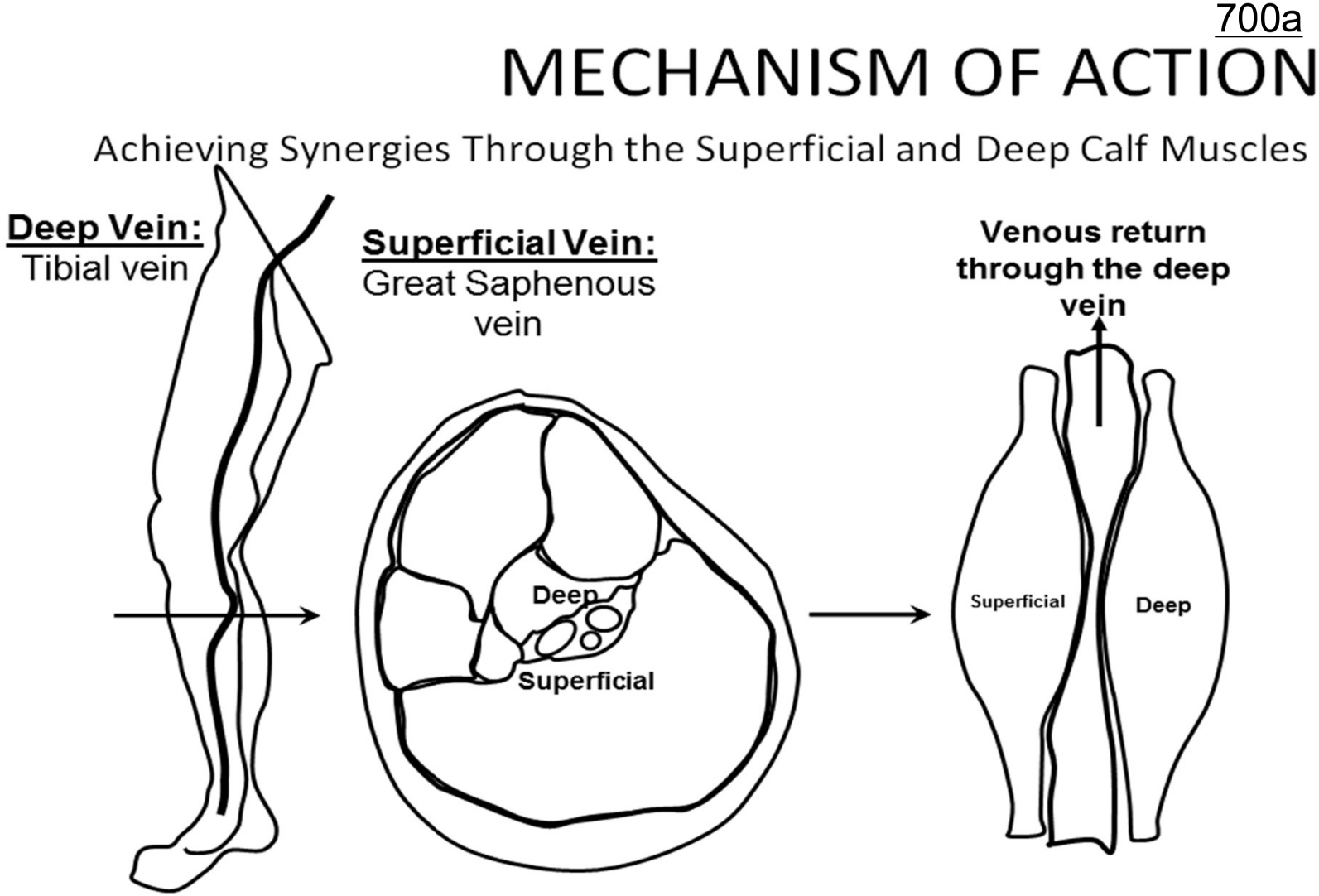

700a
MECHANISM OF ACTION
Achieving Synergies Through the Superficial and Deep Calf Muscles
Deep Vein:
Tibial vein
Superficial Vein:
Great Saphenous vein
Venous return through the deep vein
Deep
Superficial
Superficial
Deep

FIG. 7B

700b

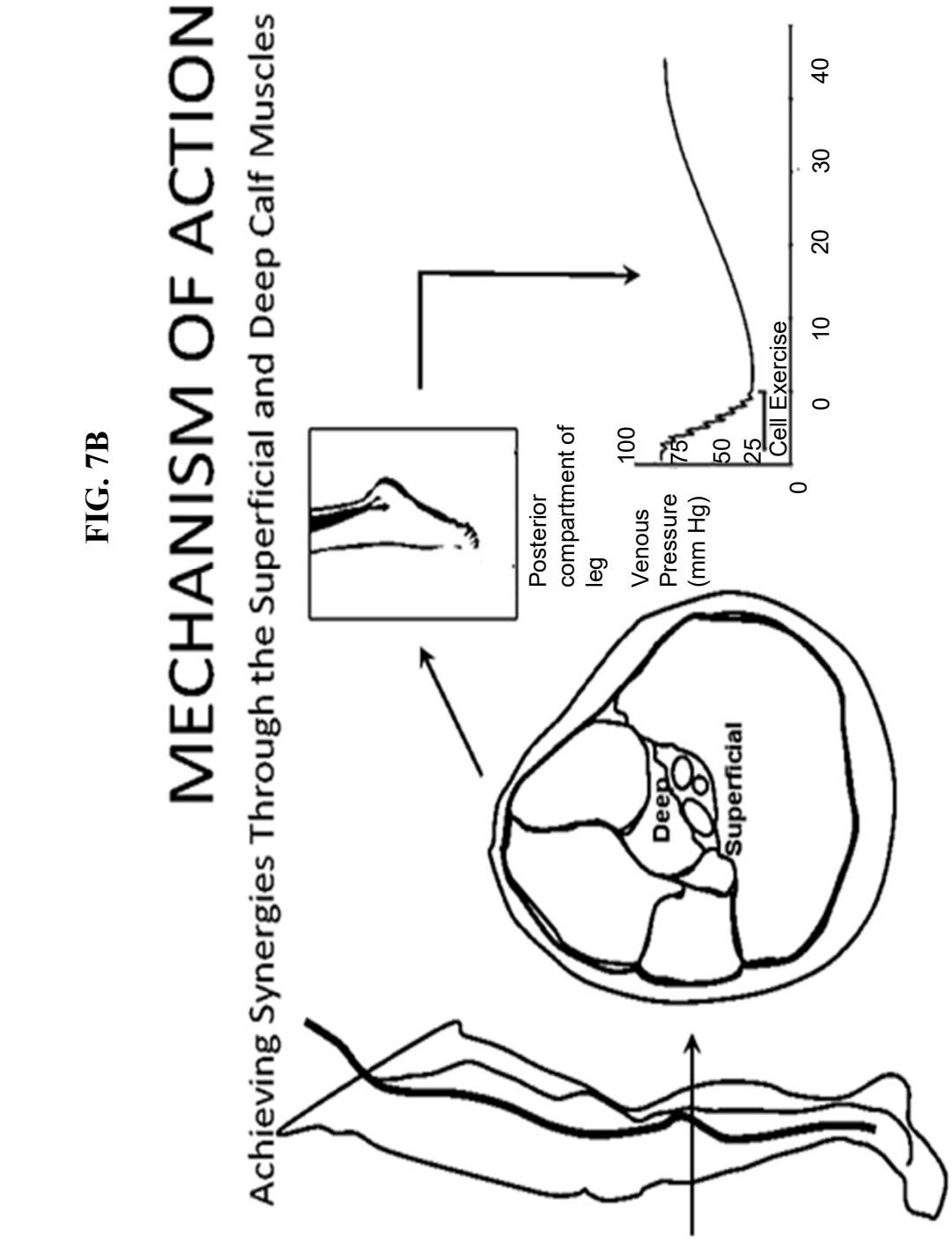

MECHANISM OF ACTION
Achieving Synergies Through the Superficial and Deep Calf Muscles
Posterior compartment of leg
Venous Pressure (mm Hg)
100
75
50
25
0
Cell Exercise
0
10
20
30
40
Deep
Superficial

FIG. 7C

700c

MECHANISM OF ACTION

Nerve Fibre Recruitment of Superficial and Deep Muscles

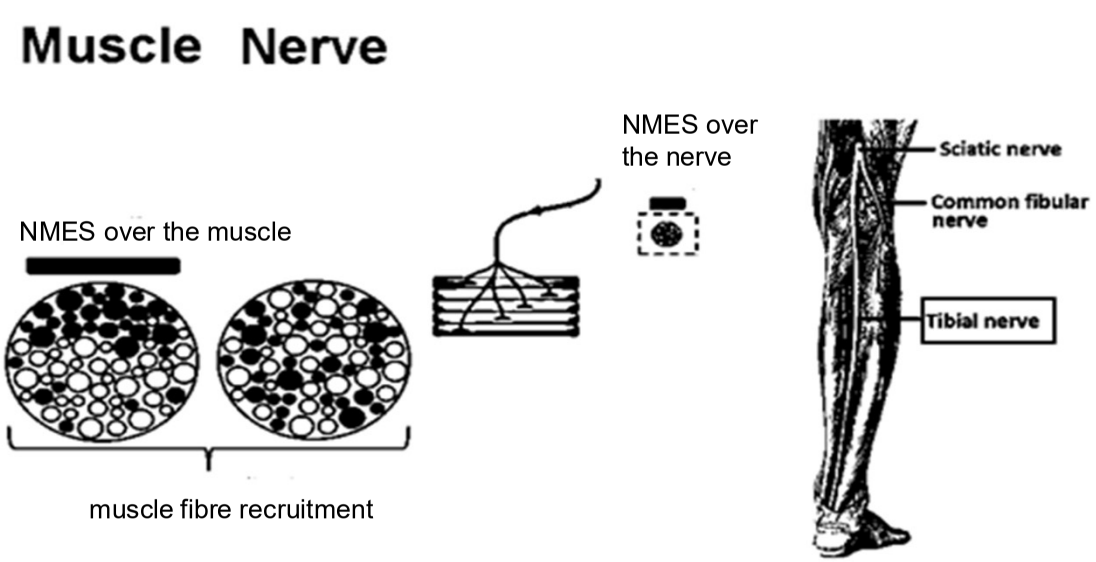


FIG. 7D

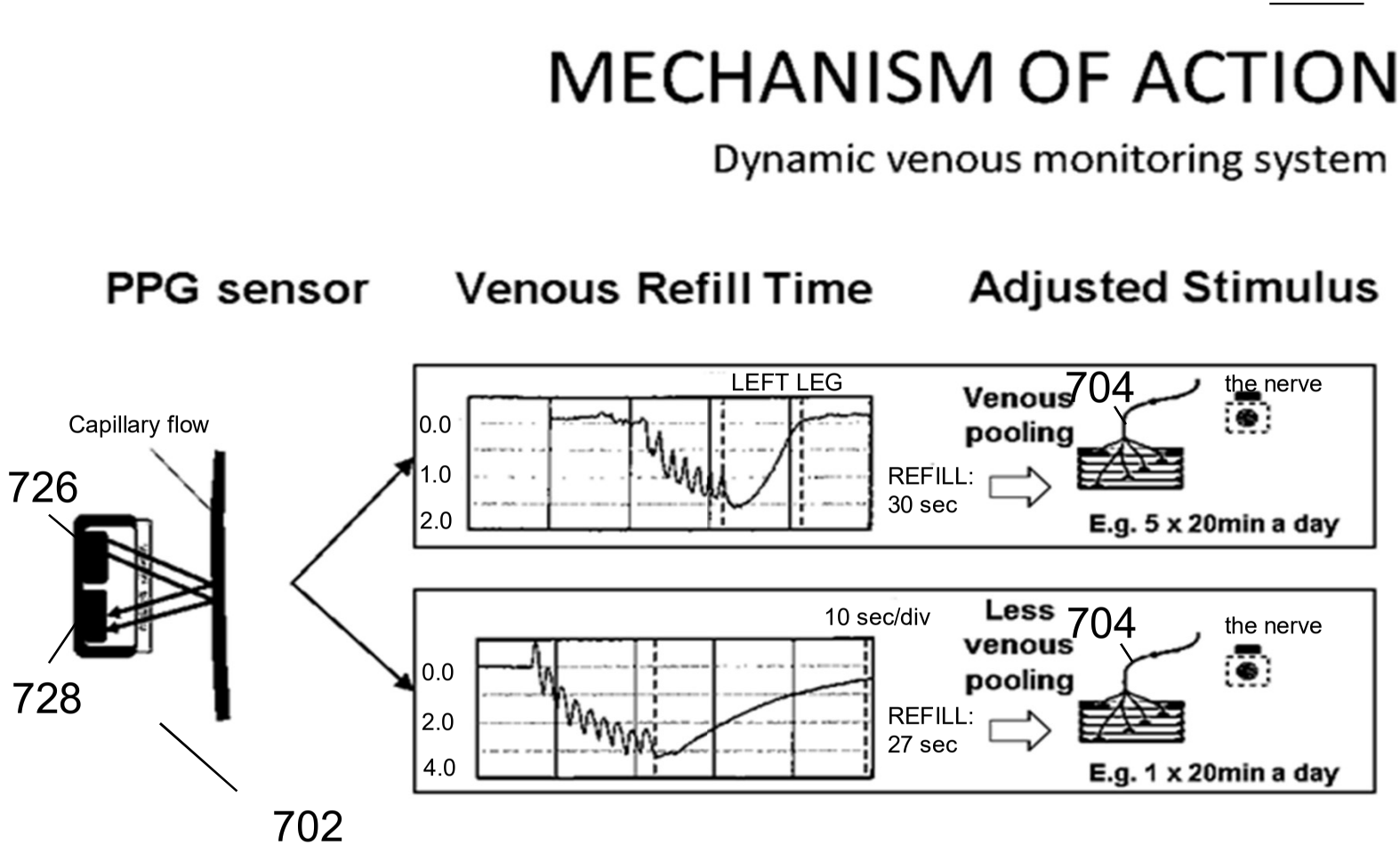

700d
MECHANISM OF ACTION
Dynamic venous monitoring system
PPG sensor
Venous Refill Time
Adjusted Stimulus
Capillary flow
726
728
702
LEFT LEG
0.0
1.0
2.0
REFILL:
30 sec
Venous pooling
704
the nerve
E.g. 5 x 20min a day
10 sec/div
0.0
2.0
4.0
REFILL:
27 sec
Less venous pooling
704
the nerve
E.g. 1 x 20min a day

FIG. 7E

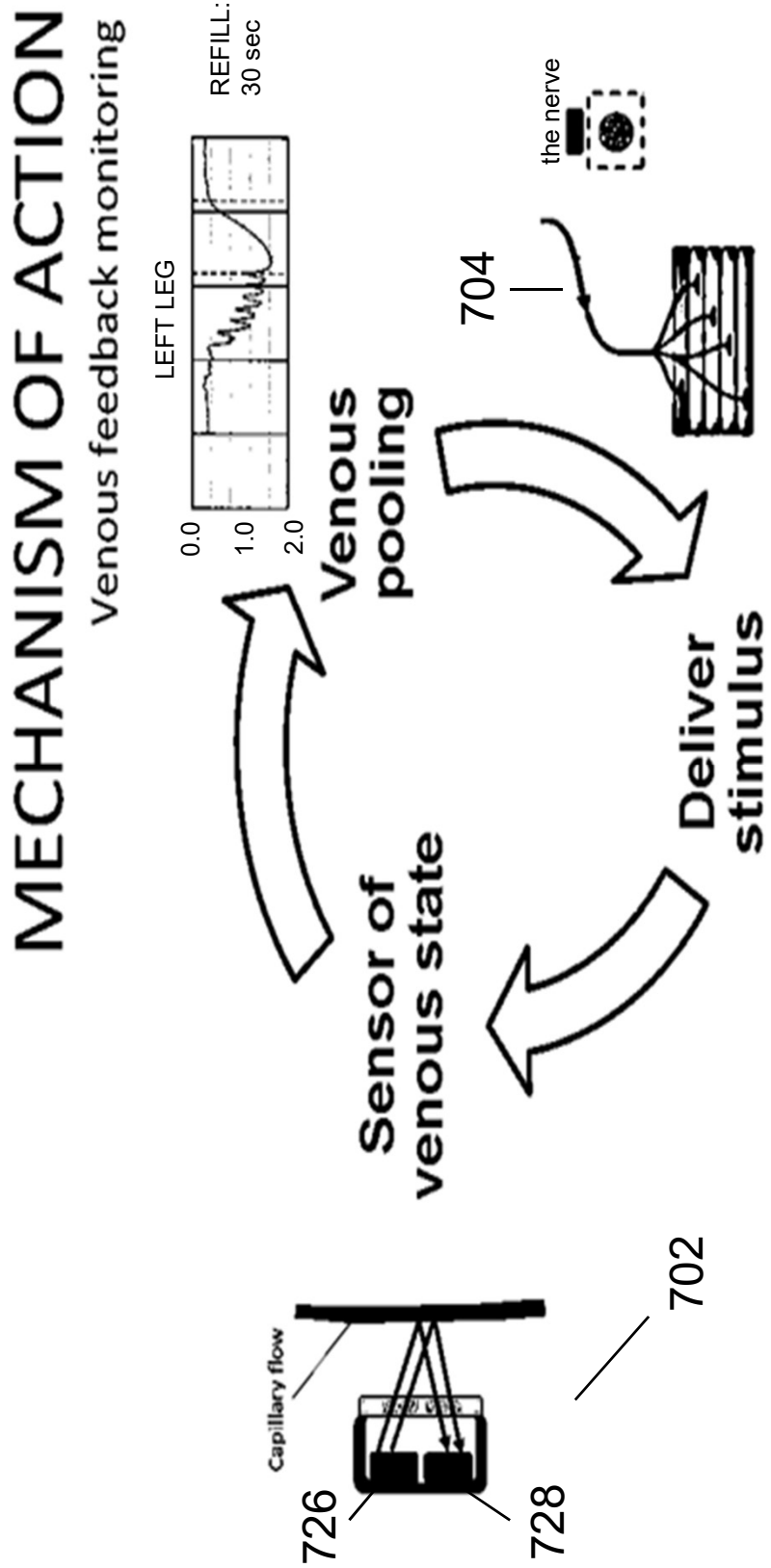

700e
MECHANISM OF ACTION
Venous feedback monitoring
LEFT LEG
REFILL:
30 sec
0.0
1.0
2.0
Venous pooling
Deliver stimulus
Sensor of venous state
the nerve
704
Capillary flow
726
728
702

FIG. 7F

700f

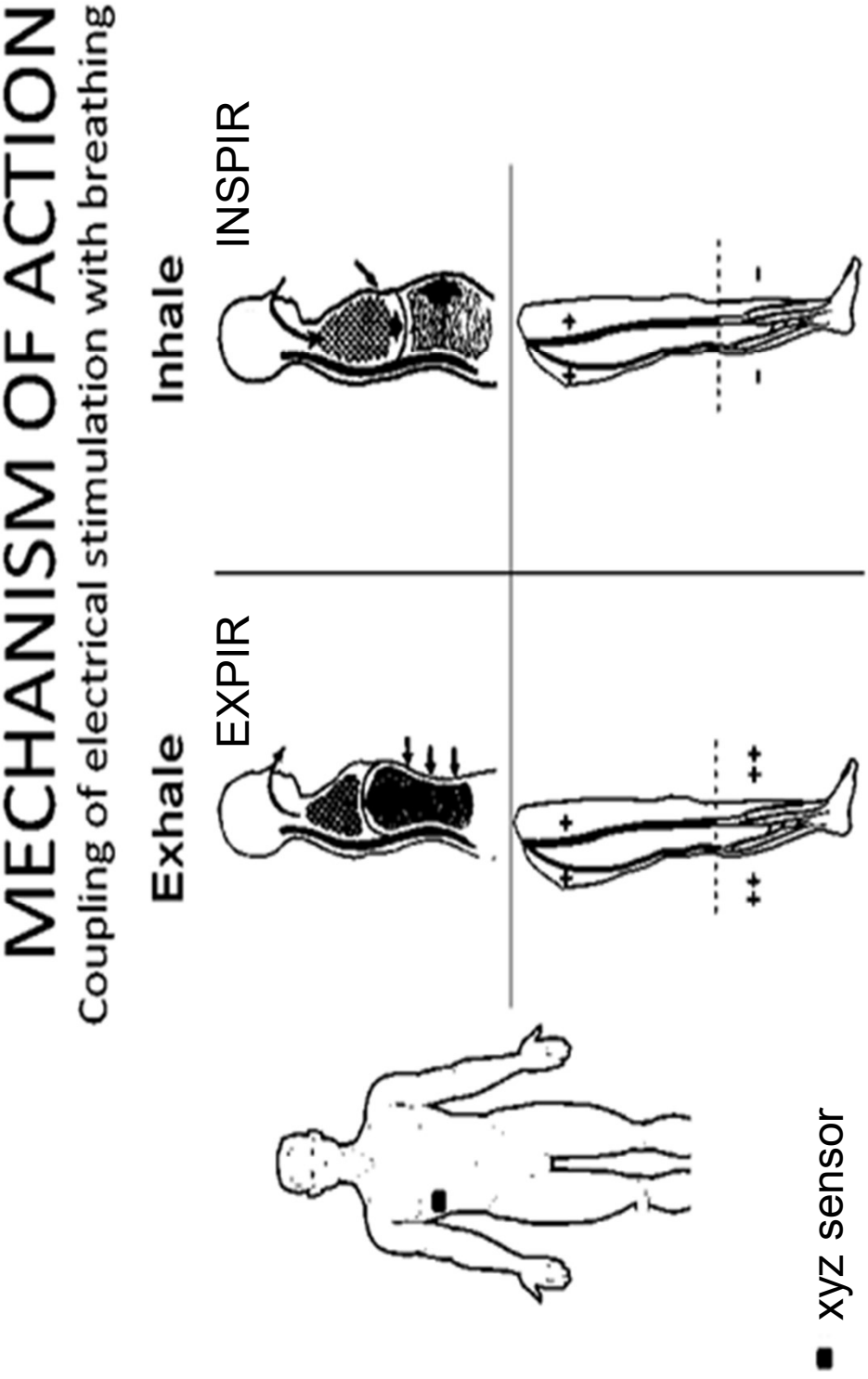

MECHANISM OF ACTION
Coupling of electrical stimulation with breathing
Inhale
Exhale
INSPIR
EXPIR
xyz sensor

FIG. 8A

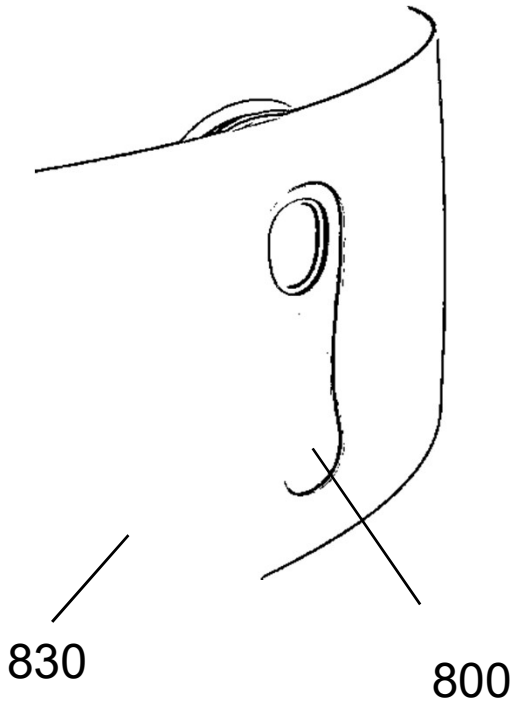


FIG. 8B

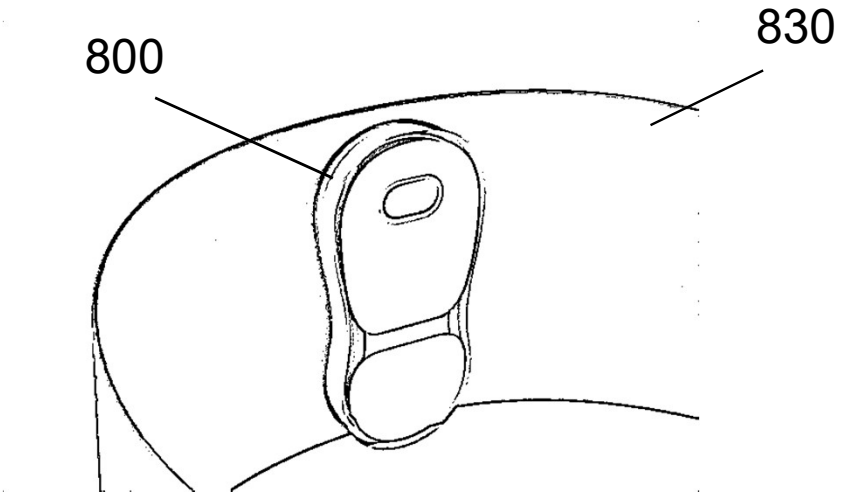


FIG. 9A

900a

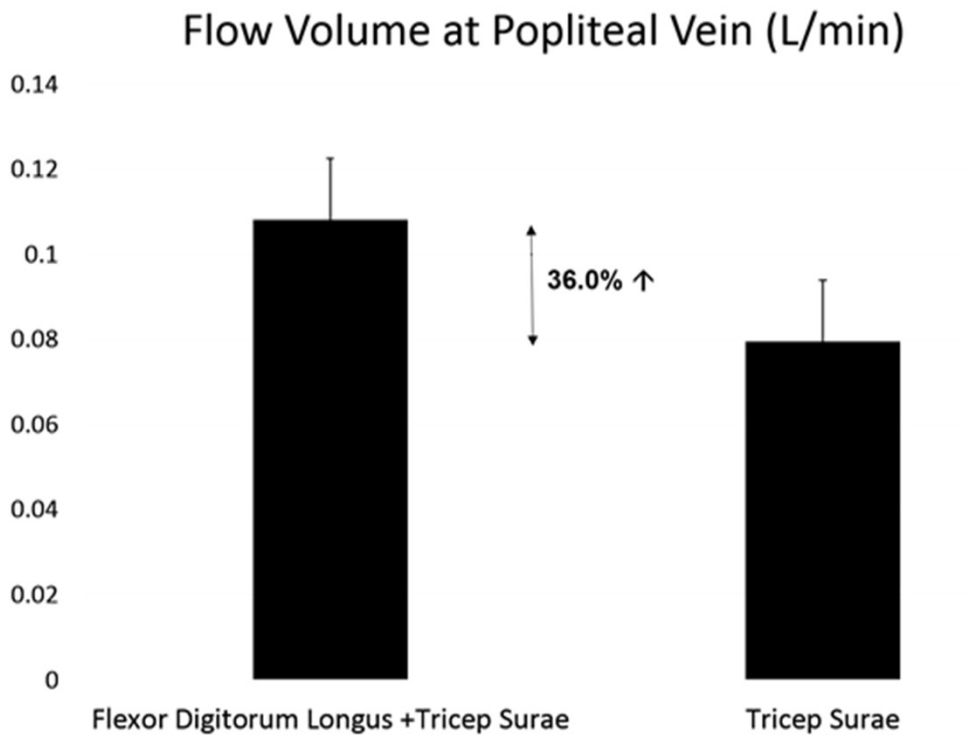

Flow Volume at Popliteal Vein (L/min)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
36.0% ↑
Flexor Digitorum Longus +Tricep Surae
Tricep Surae

FIG. 9B

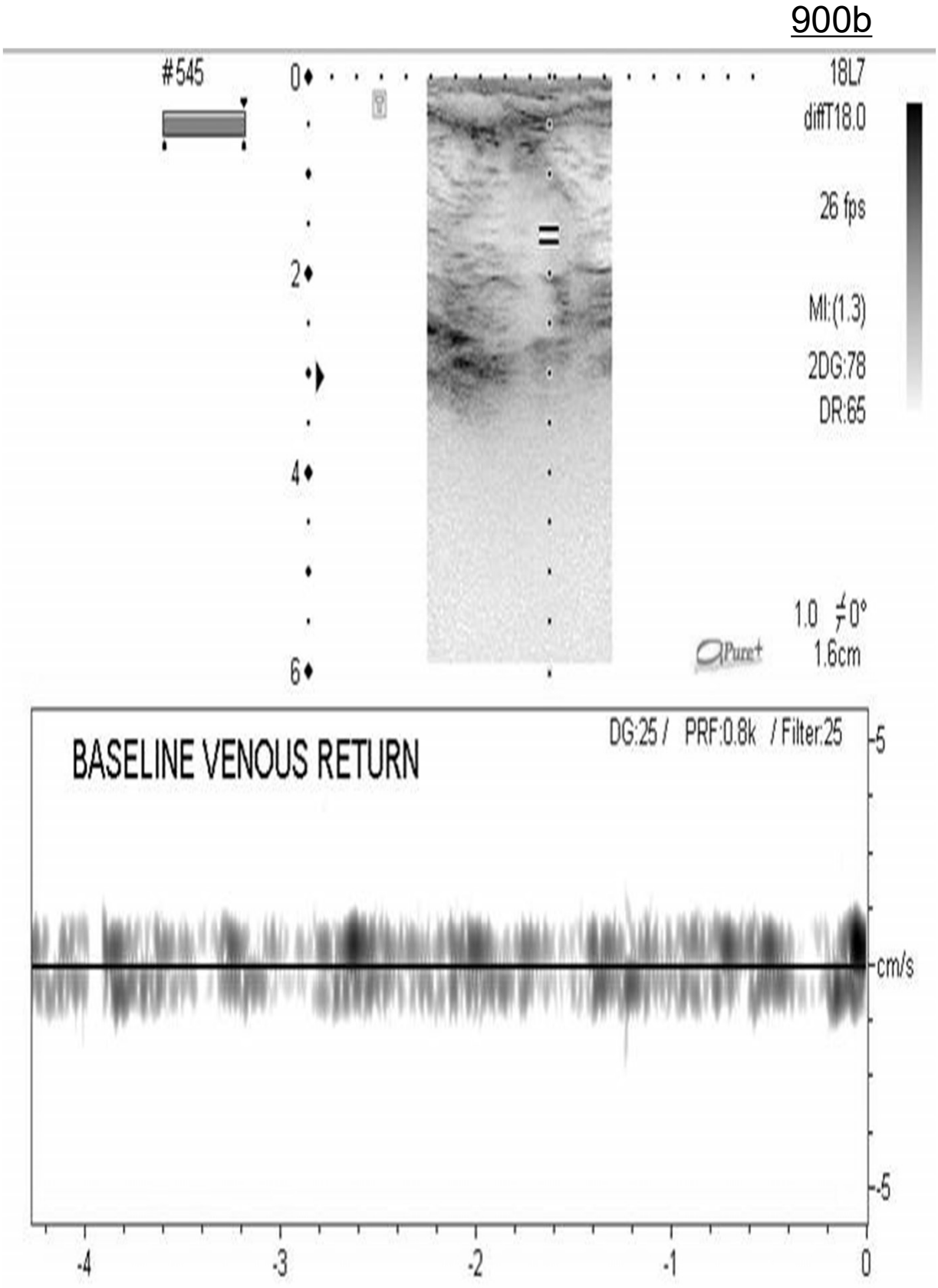
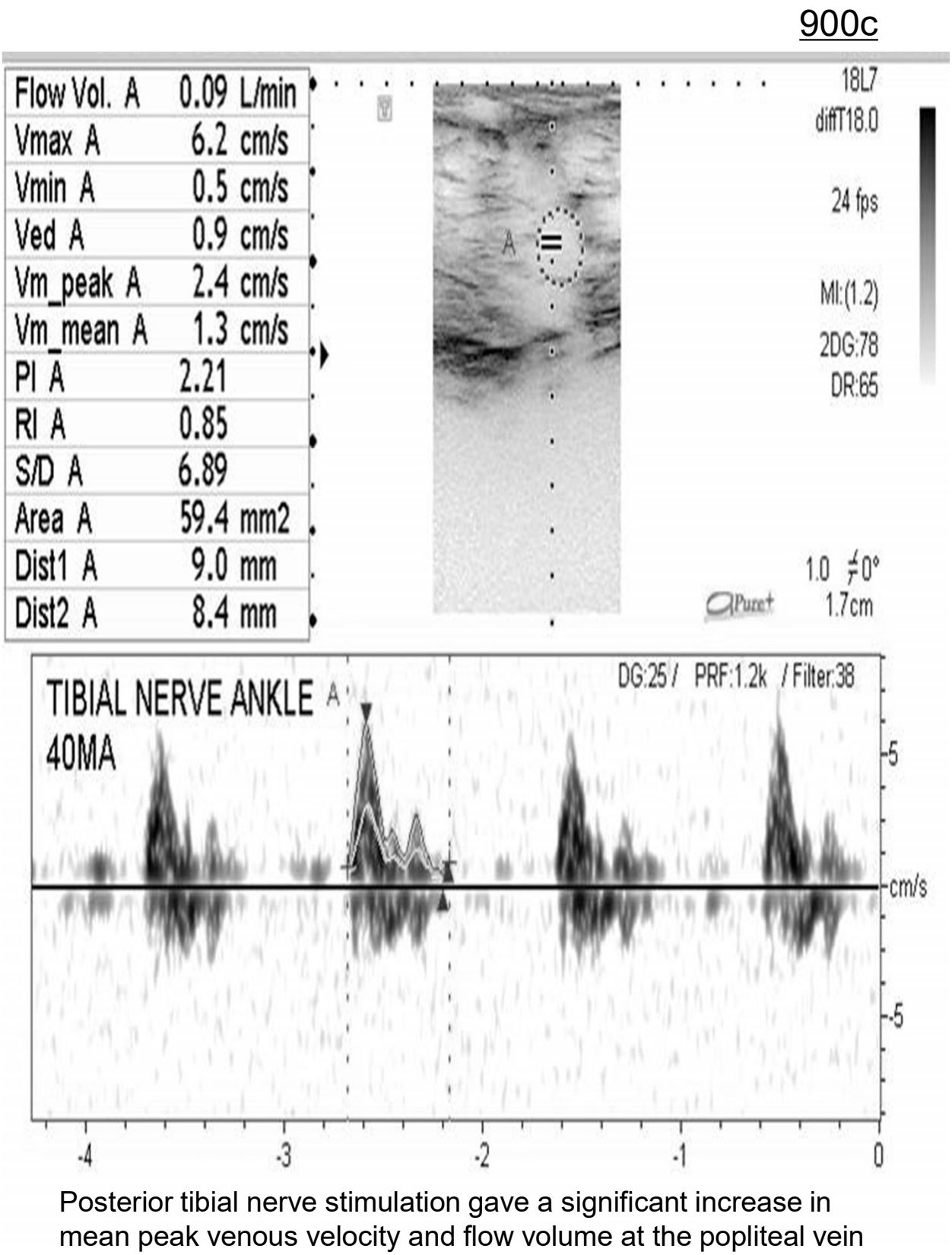

900b
#545
0
2
4
6
18L7
diffT18.0
26 fps
MI:(1.3)
2DG:78
DR:65
1.0
0°
1.6cm
BASELINE VENOUS RETURN
DG:25 / PRF:0.8k / Filter:25
5
cm/s
-5
-4
-3
-2
-1
0

FIG. 9C



Posterior tibial nerve stimulation gave a significant increase in mean peak venous velocity and flow volume at the popliteal vein compared to baseline resting venous return