

WHAT IS CLAIMED IS:

1. An invasive medical device for insertion into a patient, the device comprising:
an elongate shaft having a diameter, an outer surface, a distal tip, and a proximal end, at
5 least a portion of the elongate shaft having a first magnetic region having a first magnetic field
B1 and a length L1.
2. The invasive medical device of claim 1, wherein the invasive medical device is selected
from a guidewire, a catheter introducer, a stylet and a hypodermic needle.
10
3. The invasive medical device of claim 1, wherein and the first magnetic region includes
a discontinuity and is selected from the group consisting of a layer ferromagnetic metal, a layer
of paramagnetic metal, a notch in the outer surface of the shaft, a spot weld of magnetic metal,
a ferrule and combinations thereof.
15
4. The invasive medical device of claim 1, wherein the diameter of the elongate shaft is
sized to be inserted within an intravenous catheter, the first magnetic spaced at a distance d
from a second magnetic region having a second magnetic field B2 and second length L2,
wherein L1 and L2 are not equal.
20
5. The invasive medical device of claim 4, wherein medical device is selected from a
guidewire, a catheter introducer, a stylet and a hypodermic needle, and at least one of the first
magnetic region and the second magnetic region is selected from the group consisting of a
layer ferromagnetic metal, a layer of paramagnetic metal, a notch in the outer surface of the
25 shaft, a spot weld of magnetic metal, a ferrule and combinations thereof.
6. The invasive medical device of claim 5, wherein the elongate shaft has a third magnetic
region spaced from the second magnetic region at a distance d2 and having a third magnetic
field B3 and length L3, wherein L2 and L3 are not equal.
30

7. A system for determining relative position of a needle comprising the invasive medical device of claim 6 and magnetometers positioned with respect to the first magnetic region, the second magnetic region and the third magnetic region.
- 5 8. The invasive medical device of claim 6, wherein at least one of the first magnetic region, the second magnetic region and the third magnetic region comprise martensitic steel.
9. The invasive medical device of claim 1, wherein the diameter of the elongate shaft is sized to be inserted within an intravenous catheter, at least a portion of the elongate shaft
- 10 having a first magnetic region having a first magnetic field B1 and a first length L1 and spaced at a distance d from a second magnetic region having a second magnetic field B2 and a second length L2, wherein the first magnetic region is adjacent the distal tip.
10. The invasive medical device of claim 9, wherein medical device is selected from a
- 15 guidewire, a catheter introducer, a stylet and a hypodermic needle.
11. The invasive medical device of claim 10, wherein the second magnetic region is spaced proximally from the first magnetic region.
- 20 12. The invasive medical device of claim 11, comprising at least a third magnetic region spaced proximally from the second magnetic region, the third magnetic region having a third magnetic field B3 and length L3.
13. The invasive medical device of claim 9, wherein the first magnetic region and the
- 25 second magnetic region are encoded with data.
14. The invasive medical device of claim 13, wherein the data includes information about the invasive medical device, the information including one or more of diameter, length and type of device.
- 30 15. The invasive medical device of claim 12, wherein the first magnetic region, the second magnetic region and the third magnetic region are encoded with data.

16. The invasive medical device of claim 15, wherein the data includes information about the invasive medical device, the information including one or more of diameter, length and type of device.
- 5 17. The invasive medical device of claim 15, wherein the first, second and third magnetic regions comprises a layer ferromagnetic metal, a layer of paramagnetic metal, a spot weld of magnetic metal, a ferrule and combinations thereof.
18. The invasive medical device of claim 13, wherein the magnetic regions comprises a
10 layer ferromagnetic metal, a layer of paramagnetic metal, a spot weld of magnetic metal, a ferrule and combinations thereof.
19. The invasive medical device of claim 13, wherein the invasive medical device includes a needle.
- 15 20. The invasive medical device of claim 15, wherein the invasive medical device includes a needle.
21. A system for determining relative position of a needle comprising the invasive medical
20 device of claim 19 and magnetometers positioned with respect to the first magnetic region, and the second magnetic region.
22. A system for determining relative position of a needle comprising the invasive medical
25 device of claim 20 and magnetometers positioned with respect to the first magnetic region, the second magnetic region and the third magnetic region.
23. The system of claim 21, wherein the needle is part of a needle subassembly further including a needle hub mounted to the proximal end of the needle, and the intravenous catheter tubing is part of a catheter adapter subassembly, the catheter adapter subassembly including a
30 magnetic feature.
24. The system of claim 23, wherein the magnetometers include three different magnetometers arranged in a three-dimensional grid array as part of an ultrasound system

which can derive a three-dimensional correlation to obtain a distance from the grid array to at least one of the first magnetic field, the second magnetic field and the third magnetic field.

25. The system of claim 24, wherein the three-dimensional correlation is determined by a
5 function $I = f(B_i \mu_r)$, where $i = x$ or y or z along three axes, x , y and z are distances in three planes, B is a known magnetic field produced by the first magnetic field, the second magnetic field and the third magnetic field.

10 26. The system of claim 24, wherein the system determines relative motion of the needle and the catheter adapter subassembly.

27. The system of claim 22, wherein the needle is part of a needle subassembly further
including a needle hub mounted to the proximal end of the needle, and the intravenous catheter
15 tubing is part of a catheter adapter subassembly, the catheter adapter subassembly including a magnetic feature.

28. The system of claim 27, wherein the magnetometers include three different
magnetometers arranged in a three-dimensional grid array as part of an ultrasound system
20 which can derive a three-dimensional correlation to obtain a distance from the grid array to at least one of the first magnetic field, the second magnetic field and the third magnetic field.

29. The system of claim 28, wherein the three-dimensional correlation is determined by a
function $I = f(B_i \mu_r)$, where $i = x$ or y or z along three axes, x , y and z are distances in three
25 planes, B is a known magnetic field produced by the first magnetic field, the second magnetic field and the third magnetic field.

30. The system of claim 28, wherein the system determines relative motion of the needle
and the catheter adapter subassembly.

30 31. A method obtaining information about an invasive medical device having a distal tip, the method comprising:

encoding magnetic data on an invasive medical device with a plurality of magnetic fields, the medical device selected a guidewire, a catheter introducer, a stylet and a hypodermic needle; and

reading the data encoded on the invasive medical device.

5

32. The method of claim 31, wherein data comprises at least one of diameter of the medical device, length of the medical device and type of the medical device.

33. The method claim 31, wherein the medical device is a needle having a shaft, a distal tip and a proximal end, and the magnetic fields are space apart on the shaft.

10

34. The method of claim 31, wherein reading data from the medical device includes reading position of the magnetic fields with respect to the distal tip of the needle.

35. The method of claim 34, wherein reading the data utilizes a three-dimensional array of magnetometers as part of an ultrasound system, and the ultrasound system derives a three-dimensional correlation to obtain a distance from the array of magnetometers to at least one of the magnetic fields.

15

36. The method of claim 35, wherein the three-dimensional correlation is determined by the function $I = f(B_i \mu_r)$, where $i = x$ or y or z along three axes, x , y and z are distances in three planes, B is a known magnetic field produced by the at least one of the magnetic fields.

20