CLAIMS

1. Apparatus for generating a fluid pressure pulse downhole, the apparatus comprising:

an elongate, generally tubular housing defining an internal fluid flow passage;

a first device for controlling the flow of fluid along a first flow path which communicates with the internal fluid flow passage, to generate a first fluid pressure pulse; and

a second device for controlling the flow of fluid along a second flow path which communicates with the internal fluid flow passage, to generate a second fluid pressure pulse;

in which the first and second devices are both provided in the housing, take the form of a cartridge which can be releasably mounted in a space provided in a wall of the housing, and house a valve having a valve element and a valve seat, the valve being actuable to control the flow of fluid along the respective flow path.

2. Apparatus as claimed in claim 1, in which:

the second device is arranged to generate a second fluid pressure pulse which matches the first fluid pressure pulse; and

the first and second devices are arranged to operate such that the fluid pressure pulse generated by the apparatus is a combination of the first and second fluid pressure pulses generated by the first and second devices.

3. Apparatus as claimed in either of claims 1 or 2, in which the first and second devices are arranged to operate simultaneously.

4. Apparatus as claimed in any preceding claim, in which the devices are arranged so that the pulses they generate match, so that the pulse outputted by the apparatus has a magnitude which is the sum of the magnitudes of the individual pulses generated by the first and second devices.

5. Apparatus as claimed in any one of claims 1 to 4, in which the second device can be arranged so that it is operated independently of the first device.

6. Apparatus as claimed in any preceding claim, in which the first and second devices are arranged so that they do not impede the internal fluid flow passage defined by the housing.

7. Apparatus as claimed in any preceding claim, in which the space has an opening which is in an external surface of the housing, for insertion of the device into the space.

8. Apparatus as claimed in any preceding claim, in which the first and second devices are arranged to transmit pressure pulses to surface representative of the same data but using different pulse profiles.

9. Apparatus as claimed in any one of claims 1 to 7, in which the first and second devices are arranged to transmit pressure pulses to surface representative of different data.

10. Apparatus as claimed in any preceding claim, in which the first and second flow paths each have a respective inlet and outlet, and in which the devices define at least part of the respective flow paths.

11. Apparatus as claimed in claim 10, in which the devices define the outlets.

12. Apparatus as claimed in either of claims 10 or 11, in which the devices define the inlets.

13. Apparatus as claimed in any preceding claim, further comprising an operating unit arranged to operate both of the first and second devices.

14. Apparatus as claimed in claim 13, in which the operating unit comprises at least one of: a source of electrical power; a data acquisition system; at least one sensor; and first

and second connector elements which serve for electrically coupling the power source to the respective first and second devices and for communicating with the devices.

15. Apparatus as claimed in either of claims 13 or 14, in which the operating unit is arranged so that it does not impede the internal fluid flow passage defined by the housing.

16. Apparatus as claimed in any one of claims 13 to 15, in which the operating unit is mounted in a space provided in the wall of the tubular housing, which is separate from the space in which the first and second devices are mounted.

17. Apparatus as claimed in any preceding claim, in which the devices are provided entirely within the space.

18. Apparatus as claimed in any preceding claim, comprising at least one further device for controlling the flow of fluid along a further flow path which communicates with the internal fluid flow passage, to generate a further fluid pressure pulse.

19. Apparatus as claimed in any preceding claim, in which the housing defines an upset which is upstanding from a circumferential outer surface of the housing, and which defines the space, and in which the fluid flow passage of the housing has an unrestricted diameter extending along a length of the housing.

20. Apparatus as claimed in any preceding claim wherein, in use, the generation of fluid pressure pulses is achieved without restricting a bore of the primary fluid flow passage.

21. A method of generating a fluid pressure pulse downhole, the method comprising the steps of:

locating an elongate, generally tubular housing defining an internal fluid flow passage downhole in a well;

releasably mounting a first device in a space provided in a wall of the housing, the device taking the form of a cartridge housing a valve having a valve element and a valve

seat, the valve being actuable to control the flow of fluid along a first flow path which communicates with the internal fluid flow passage;

releasably mounting a second device in a space provided in a wall of the housing, the device taking the form of a cartridge housing a valve having a valve element and a valve seat, the valve being actuable to control the flow of fluid along a second flow path which communicates with the internal fluid flow passage; and

operating the first and second devices to control the flow of fluid along the respective flow paths and thereby generate corresponding first and second fluid pressure pulses.

22. A method as claimed in claim 21, comprising operating the first and second devices simultaneously.

23. A method as claimed in either of claims 21 or 22, comprising arranging the first and second devices so that the first and second pressure pulses match, and so that a fluid pressure pulse outputted by the apparatus is a combination of the first and second fluid pressure pulses generated by the first and second devices.

24. A method as claimed in claim 23, comprising arranging the devices so that the pulses generated by the devices complement one-another.

25. A method as claimed in claim 21, comprising operating the second device independently of the first device.

26. A method as claimed in claim 21 or 25, in which the first and second devices are operated so that there is a time delay between operation of the first device and operation of the second device.

27. A method as claimed in claim 23, in which the method is a method of transmitting data relating to at least one downhole parameter to surface via the combined fluid pressure pulses.

28. A method as claimed in claim 21, in which the first and second devices are operated to transmit pressure pulses to surface representative of the same data, but using different pulse profiles.

29. A method as claimed in claim 21, in which the first and second devices are operated to transmit pressure pulses to surface representative of different data.

30. A method as claimed in any one of claims 21 to 29, comprising providing at least one further device for controlling the flow of fluid along a further flow path which communicates with the internal fluid flow passage; and operating the first, second and further devices to control the flow of fluid along the respective flow paths and thereby generate corresponding first, second and further pressure pulses.

31. A method as claimed in claim 30, in which the further device is operated to generate a further fluid pressure pulse; and the method comprises arranging the devices so that the first, second and further pressure pulses match, and so that a fluid pressure pulse outputted by the apparatus is a combination of the first, second and further fluid pressure pulses generated by the devices.

32. Apparatus for generating a fluid pressure pulse downhole, the apparatus comprising:

an elongate, generally tubular housing defining an internal fluid flow passage;

a first device for controlling the flow of fluid along a first flow path which communicates with the internal fluid flow passage, to generate a first fluid pressure pulse; and

a second device for controlling the flow of fluid along a second flow path which communicates with the internal fluid flow passage, to generate a second fluid pressure pulse which matches the first fluid pressure pulse;

in which the first and second devices are arranged to operate such that the fluid pressure pulse generated by the apparatus is a combination of the first and second fluid pressure pulses generated by the first and second devices.

CLAIMS

1. An apparatus for generating a fluid pressure pulse downhole, the apparatus comprising:

an elongate tubular housing defining an internal fluid flow passage;

a first device coupled to the housing for controlling a flow of fluid along a first flow path that communicates with the internal fluid flow passage to generate a first fluid pressure pulse; and

a second device coupled to the housing for controlling a flow of fluid along a second flow path that communicates with the internal fluid flow passage to generate a second fluid pressure pulse, wherein the first and second devices are releasably mounted in corresponding spaces defined in a wall of the housing, and wherein the first and second devices each house a valve having a valve element and a valve seat, the valve being actuatable to control the flow of fluid along the first and second flow paths, respectively.

2. The apparatus of claim 1, wherein the first and second fluid pressure pulses exhibit the same pulse profile to generate a combined fluid pressure pulse.

3. The apparatus of claim 1, wherein the first and second devices operate independently.

4. The apparatus of claim 1, wherein the first and second devices are mounted to the housing such that fluid flow within the internal fluid flow passage is unobstructed by the first and second devices.

5. The apparatus of claim 1, wherein the corresponding spaces defined in the wall of the housing are each defined in an external surface of the housing.

6. The apparatus of claim 1, wherein the first and second pressure pulses are transmitted using different pulse profiles but are representative of the same data.

7. The apparatus of claim 1, wherein data transmitted via the first pressure pulse is different from data transmitted via the second pressure pulse.

8. The apparatus of claim 1, wherein the first and second each provide a respective inlet and outlet, and wherein the first and second devices each define at least part of the first and second flow paths, respectively.

9. The apparatus of claim 1, further comprising an operating unit coupled to the housing to operate the first and second devices, wherein the operating unit is mounted to the housing such that fluid flow within the internal fluid flow passage is unobstructed by the operating unit.

10. The apparatus of claim 9, wherein the operating unit comprises at least one of:

a source of electrical power;

a data acquisition system;

at least one sensor; and

first and second connector elements that electrically couple the source of electrical power to the first and second devices and facilitate communication with the first and second devices.

11. The apparatus of claim 1, wherein the housing defines an upset that extends radially outward from a circumferential outer surface of the housing, and wherein the corresponding spaces are defined in the upset.

12. The apparatus of claim 1, wherein the first and second fluid pressure pulses are generated without restricting a bore of the primary fluid flow passage.

13. A method of generating a fluid pressure pulse downhole, the method comprising:

locating an elongate tubular housing defining an internal fluid flow passage in a well;

releasably mounting a first device in a first space provided in a wall of the housing, the first device including a first valve having a first valve element and a first valve seat, the first valve being actuatable to control a flow of fluid along a first flow path that communicates with the internal fluid flow passage;

releasably mounting a second device in a second space provided in the wall of the housing, the second device including a second valve having a second valve element and a second valve seat, the second valve being actuatable to control a flow of fluid along a second flow path that communicates with the internal fluid flow passage; and

operating the first and second devices to control the flow of fluid along the first and second flow paths, respectively, and thereby generating corresponding first and second fluid pressure pulses.

14. The method of claim 13, further comprising operating the first and second devices simultaneously.

15. The method of claim 13, further comprising generating the first and second fluid pressure pulses with the same pulse profile and thereby generating a combined fluid pressure pulse.

16. The method of claim 13, further comprising operating the first and second devices independently of one another.

17. The method of claim 13, wherein operating the first and second devices comprises:

operating the first device; and

operating the second device following a time delay after operating the first device.

18. The method of claim 13, further comprising transmitting data relating to at least one downhole parameter to surface via the first and second fluid pressure pulses.

19. The method of claim 13, wherein operating the first and second devices comprises:

operating the first device to generate the first fluid pressure pulse; and

operating the second device to generate the second fluid pressure pulse, wherein a pulse profile of each fluid pressure pulse is different, data transmitted via each fluid pressure pulse is the same.

20. The method of claim 13, wherein operating the first and second devices comprises:

operating the first device to generate the first fluid pressure pulse; and

operating the second device to generate the second fluid pressure pulse, wherein data transmitted via each fluid pressure pulse is different.

21. An apparatus for generating a fluid pressure pulse downhole, the apparatus comprising:

an elongate tubular housing defining an internal fluid flow passage;

a first device coupled to the housing for controlling a flow of fluid along a first flow path that communicates with the internal fluid flow passage to generate a first fluid pressure pulse; and

a second device coupled to the housing for controlling a flow of fluid along a second flow path that communicates with the internal fluid flow passage to generate a second fluid pressure pulse,

wherein a pulse profile of the first fluid pressure pulse matches a pulse profile of the second fluid pressure pulse, and

wherein the first and second fluid pressure pulses generate a combined fluid pressure pulse.