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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;

wherein the first and second fluid pressure pulses exhibit the same pulse profile to generate a combined fluid pressure pulse.

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

3. 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.

4. 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.

5. 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.

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

7. 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.

8. 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.

9. The apparatus of claim 8, 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.

10. 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.

11. 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.

12. 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;

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; and

generating the first and second fluid pressure pulses with the same pulse profile and thereby generating a combined fluid pressure pulse.

13. The method of claim 12, further comprising operating the first and second devices simultaneously.

14. The method of claim 12, further comprising operating the first and second devices independently of one another.

15. The method of claim 12, 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.

16. The method of claim 12, further comprising transmitting data relating to at least one downhole parameter to surface via the first and second fluid pressure pulses.

17. The method of claim 12, 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.

18. The method of claim 12, 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.

19. 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.

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 arranged at a common axial position along a length of the housing and releasably mounted in a side-by-side orientation 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;

wherein the first and second fluid pressure pulses exhibit the same pulse profile to generate a combined fluid pressure pulse.

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

3. 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.

4. 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.

5. 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.

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

7. 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.

8. 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.

9. The apparatus of claim 8, 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.

10. 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.

11. 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.

12. 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, wherein the first and second devices are arranged at a common axial position along a length of the housing and mounted in a side-by-side orientation;

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; and

generating the first and second fluid pressure pulses with the same pulse profile and thereby generating a combined fluid pressure pulse.

13. The method of claim 12, further comprising operating the first and second devices simultaneously.

14. The method of claim 12, further comprising operating the first and second devices independently of one another.

15. The method of claim 12, 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.

16. The method of claim 12, further comprising transmitting data relating to at least one downhole parameter to surface via the first and second fluid pressure pulses.

17. The method of claim 12, 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.

18. The method of claim 12, 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.

19. 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 arranged at a common axial position along a length of the housing and mounted in a side-by-side orientation,

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.