

COMPOSITE WATER-CONTROLLING AND FLOW-LIMITING DEVICE AND SCREEN PIPE THEREOF

TECHNICAL FIELD

[0001] The invention relates to a water-controlling and flow-limiting device, and particularly to a composite water-controlling and flow-limiting device and a screen pipe thereof.

BACKGROUND ART

[0002] During exploitation of oil and natural gas, horizontal wells are largely developed and applied due to advantages of high liquid production capacity, small differential pressure of production and low flow resistance. The horizontal wells have the characteristic of imbalance of the flowing production liquid profile, and with exploitation time prolonged, such imbalance flowing profile will cause earlier water breakthrough to reduce life of the well, and affect production capability of the well.

[0003] Water-controlling technology of the current horizontal wells uses two methods. One is a passive water-controlling method of finding water firstly, and then controlling water. Such method is complicated in construction process, has a high technical requirement and more procedures, and is difficult in operation in the production state. Once water coning occurs, this water-controlling method is failure. The other controls water using an inflow control tool, and prolongs balanced depressurization of the horizontal well section through sand prevention filter and throttle regulation, which can suppress phenomenon of imbalance of water crest movement of bottom water and edge water, thereby improving production capacity of the entire horizontal section, and prolonging life of the horizontal wells. However, the above technology must collect oil data in advance for design and field

regulation. In addition, inflow control of some automatic water-controlling technology is relatively single, and it is difficult to achieve water-controlling of the whole period.

DISCLOSURE OF THE PRESENT INVENTION

[0004] With respect to the deficiencies of the prior art, the technical problem to be solved by the invention is to provide a composite water-controlling and flow-limiting device and a screen pipe thereof, which can automatically control the flow of fluid according to fluid characteristics, balance the inflow profile, implement simple and easy-to-operate active water control and oil-stabilizing production, and allow the water-controlling and oil-increasing functions thereof to be effective during the entire production period of an oil well.

[0005] To achieve the above object, the invention provides a composite water-controlling screen pipe, comprising:

- a base pipe;

- a self-adaptive internal flow control device mounted on the base pipe and used for a circulation channel for fluids inside and outside the base pipe and controlling an opening degree of the circulation channel according to the change in viscosity of different fluids so as to automatically limit flow;

- a flow control device mounted on the base pipe and adjacent to the self-adaptive internal flow control device for controlling an overflow of the base pipe; and

- a screen pipe coaxially and threadedly connected to the base pipe, wherein an inner diameter of the screen pipe is the same as that of the base pipe.

[0006] As regards to the composite water-controlling screen pipe, the self-adaptive internal flow control device is in a float-type structure, and controls an opening degree of a buoy according to the change in viscosity of different fluids so as to automatically limit flow.

[0007] As regards to the composite water-controlling screen pipe, the self-adaptive internal flow control device is made of tungsten carbide hard alloy.

[0008] As regards to the composite water-controlling screen pipe, the flow control device comprises:

a support diversion disc opened with an overflow groove and a diversion pipe; and

a rotatable balance disc connected to the support diversion disc, and provided with a throttle hole to cooperate with the overflow groove and the diversion pipe, the balance disc rotated as needed to regulate the number of plugged holes of the throttle hole to control the overflow of the base pipe, and locked with a lock nut.

[0009] As regards to the composite water-controlling screen pipe, the throttle hole is mounted with a tungsten alloy nozzle.

[0010] As regards to the composite water-controlling screen pipe, the screen pipe comprises:

a body; and

a filter sleeve comprising an outer protective jacket, a filter jacket and an inner protective jacket fitted sequentially, the filter jacket comprising a plurality of filter screens stacked successively, wherein hole sizes of the filter screens are set depending on requirement for oil reservoir.

[0011] As regards to the composite water-controlling screen pipe, the inner protective jacket, the outer protective jacket and the filter screen are all made of acid-proof and antiseptic materials.

[0012] As regards to the composite water-controlling screen pipe, both ends of the filter sleeve are respectively welded to the flow control device and a positioning step of the body, and fluid flowing through the filter screen flows into the base pipe via the self-adaptive internal flow control device after passing through the flow control device.

[0013] As regards to the composite water-controlling screen pipe, the filter sleeve is fixed onto the body via a support disc.

[0014] To better achieve the above object, the invention further provides a composite water-controlling and flow-limiting device, comprising a composite water-controlling screen pipe, wherein the composite water-controlling screen pipe is the above-mentioned composite water-controlling screen pipe.

[0015] Hereinafter the invention is explicitly described with reference to accompanying drawings and detailed embodiments, but the invention is not limited thereto.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1 is a structure diagram of one embodiment according to the invention.

[0017] FIG. 2 is a partial enlarged diagram of a self-adaptive internal flow control device and a flow control device in one embodiment of the invention.

[0018] FIG. 3 is a water-controlling diagram during early production of a composite water-controlling screen pipe according to the invention.

[0019] FIG. 4 is a water-controlling diagram during middle and late production of the composite water-controlling screen pipe according to the invention.

EMBODIMENTS

[0020] Hereinafter structure principle and operating principle of the invention are specifically described with reference to the accompanying drawings:

[0021] Referring to FIG. 1, which is a structure diagram of one embodiment according to the invention. The composite water-controlling and flow-limiting device of the invention comprises a composite water-controlling screen pipe, comprising: a base pipe 1; a self-adaptive internal flow control device 3 mounted on the base pipe 1 for a single circulation

channel for fluids inside and outside the base pipe 1, and based on the principle of constancy of a sum of fluid dynamic pressure and local pressure loss in Bernoulli equation, controlling an opening degree of a buoy within a valve body according to the change in viscosity of different fluids flowing through the valve body to control an opening degree of the circulation channel so as to automatically limit flow; a flow control device 4 mounted on the base pipe 1 and adjacent to the self-adaptive internal flow control device 3 for controlling an overflow of the base pipe 1; and a screen pipe coaxially and threadedly connected to the base pipe 1, wherein an inner diameter of the screen pipe is the same as that of the base pipe 1. The screen pipe comprises: a body 8; and a filter sleeve 5 comprising an outer protective jacket, a filter jacket and an inner protective jacket fitted sequentially, the filter jacket comprising a plurality of filter screens stacked successively, wherein hole sizes of the filter screens are set depending on requirement for oil reservoir. The inner protective jacket, the outer protective jacket and the filter screen are all made of acid-proof and antiseptic materials such as SS304, SS316, or higher level. Both ends of the filter sleeve 5 are respectively welded to the flow control device 4 and a positioning step of the body 8, and fluid flowing through the filter screen flows into the base pipe 1 via the self-adaptive internal flow control device 3 after passing through the flow control device 4. The filter sleeve 5 is fixed onto the body 8 via a support disc 6. One end of the body 8 is further mounted with a collar 7.

[0022] Referring to FIG. 2, which is a partial enlarged diagram of the self-adaptive internal flow control device 3 and the flow control device 4 in one embodiment of the invention. The self-adaptive internal flow control device 3 is preferably in a float-type structure, and controls the opening degree of the buoy according to the change in viscosity of various fluids so as to limit flow automatically. The self-adaptive internal flow control device 3 is preferably made of tungsten carbide hard alloy, and has the advantages of heat resistance,

pressure resistance and corrosion prevention. The flow control device 4 comprises: a support diversion disc 41 opened with an overflow groove 43 and a diversion pipe 44; a rotatable balance disc 42 connected to the support diversion disc 41, and provided with a throttle hole 45 to cooperate with the overflow groove 43 and the diversion pipe 44, the balance disc 42 rotated as needed before operation to regulate the number of plugged holes of the throttle hole 45 to control the overflow of the base pipe 1, and locked with a lock nut. The throttle hole 45 is preferably mounted with a tungsten alloy nozzle.

[0023] The base pipe 1 and the body 8 of the screen pipe are threadedly connected. During assembly, the self-adaptive internal flow control device 3 is firstly assembled, and the flow control device 4, the self-adaptive internal flow control device and the lock nut 2 are assembled sequentially from one end, then the support disc 6 and the filter sleeve 5 are assembled on the body 8 of the screen pipe, and next, the self-adaptive internal flow control device 3 is threadedly connected to the screen pipe. The base pipe 1 of the self-adaptive internal flow control device 3 is provided with a male thread, which functions to connect upper and lower pipe columns together with the collar 7, and the support disc 6 functions to fix the filter sleeve 5. The fluid carrying sand filters the sand outside the screen pipe after filtering of the filter sleeve 5, the fluid without sand flows through the flow control device 4 for overflow limitation, and then the fluid passes through the self-adaptive internal flow control device 3 for overflow limitation, enters into the body 8 of the device and rises to a mouth of the well along with the pipe columns.

[0024] Referring to FIGS. 3 and 4, the single composite water-controlling screen pipe can only limit inflow of the fluid, and only if the entire pipe string is designed after stratigraphic analysis, the inflow profile can be balanced. Oil and water profile of the stratum and information of permeability, pressure and water holding of each section are obtained by performing physical property analysis on the stratum of pitshaft, and then the number of

flow channels of the flow control device 4 are set according to data to control inflow of the fluid, regulate the oil and water profile, and prevent partial coning of bottom water or edge water, which are to balance the inflow profile by the way of controlling fluid flow during early period (see FIG. 3). During middle and late period, since partial well section may have water breakthrough, it is also difficult for the flow control device 4 to take effect, and at this time, the self-adaptive internal flow control device 3 is turned on or off according to fluid properties. After water breakthrough, the self-adaptive internal flow control device 3 is turned off, such that oil recovery of other layer can be enhanced.

[0025] The water-controlling principle of the invention fully reflects the life cycle design conception, and the water-controlling and oil-increasing functions thereof are effective during the entire production period of an oil well. According to characteristics of the invention, the water-controlling mechanism of the device combining with the production period of the oil well can be divided into two water-controlling stages. The first water-controlling stage is early production of the oil well. The number of hole plates on the flow control device 4 is designed with numerical simulation software according to actual data of oil and gas reservoir, and differential pressure of production of each section is reasonably controlled to maintain balance of oil and water interface, prevent earlier water breakthrough, delay coning of edge water and bottom water, and achieve the object of earlier liquid control while remedying the deficiency of incapability of controlling liquid of the self-adaptive internal flow control device 3 during the early period. The second water-controlling stage is middle and late production of the oil well. Different production sections of the oil well have different water holding degrees, and the float-type self-adaptive internal flow control device 3 can change the opening degree of the buoy according to different water holding degrees (i.e., comprehensive viscosities of fluids) of the production segments, thereby achieving automatic water-controlling throttle effect.

[0026] Of course, the invention may further have several other embodiments, and those skilled in the art shall make various corresponding modifications and variations according to the invention without departing from spirit and essence of the invention, but these corresponding modifications and variations shall belong to the extent of protection of the appended claims of the invention.

Industrial Applicability

[0027] As compared to the water-controlling screen pipe of the conventional water-controlling and flow-limiting device, the composite water-controlling and flow-limiting device of the invention has a strong effect of limiting flow during the early period, and can suppress water automatically according to the change in viscosity of the fluid during the middle and late period, and the water-controlling and oil-increasing functions thereof are effective during the entire production period of the oil well.

[0028] A filtering portion of the composite water-controlling and flow-limiting device uses the form of an integral sleeve, and has the characteristics of good permeability, high strength, strong non-deformability, and good corrosion prevention.

[0029] A step of the filtering portion of the composite water-controlling and flow-limiting device is tightly connected to the base pipe using a hexagon bolt, and then using surface welding. Such specific process can effectively prevent slippage between the base pipe and the filter medium that may be caused when going down to the well while ensuring concentricity of the whole screen pipe, and improving strength of the screen pipe and safety of entry. The inner protective sleeve uses a bridge structure to have an annular discharge area, changes oil flowing channel, prevents sand deposition of the filter medium, and solves blocking of the screen pipe. Moreover, the filter medium is made in a form of sleeve, and directly fitted on the base pipe and fixed onto the step, and an annular space is left between

the sleeve and the base pipe, so that the screen pipe forms pipe flow during permeation, which greatly enhances penetration capacity of the screen pipe and oil recovery of the oil well.

[0030] The composite water-controlling and flow-limiting device has a unique float-type self-adaptive internal flow control device, which can automatically limit flow of the fluid according to the change in viscosity of the fluid.

[0031] The core component of the composite water-controlling and flow-limiting device is made of tungsten alloy, and has the advantages of heat resistance, pressure resistance and corrosion prevention. In particular, the speed-limiting device is hardened by special process, which can prevent sand shock and corrosion of the fluid, and has a long life.

[0032] The composite water-controlling and flow-limiting device has a good adaptability to the horizontal well, is convenient in installation, and has simple programs.

[0033] The composite water-controlling and flow-limiting device is advanced in process, and strongly targeted. The number of throttle holes on the flow control device is designed with numerical simulation software according to actual data of oil and gas reservoir, and differential pressure of production of each section is reasonably controlled to maintain balance of oil and water interface, prevent earlier water breakthrough, delay coning of edge water and bottom water, and achieve the object of earlier liquid control. During the middle and late period, the float-type self-adaptive internal flow control device can suppress water automatically according to the change in viscosity of the fluid.

WHAT IS CLAIMED IS:

1. A composite water-controlling screen pipe, comprising:

a base pipe;

a self-adaptive internal flow control device mounted on the base pipe and used for a circulation channel for fluids inside and outside the base pipe and controlling an opening degree of the circulation channel according to the change in viscosity of different fluids so as to automatically limit flow;

a flow control device mounted on the base pipe and adjacent to the self-adaptive internal flow control device for controlling an overflow of the base pipe; and

a screen pipe coaxially and threadedly connected to the base pipe, wherein an inner diameter of the screen pipe is the same as that of the base pipe.

2. The composite water-controlling screen pipe according to claim 1, wherein the self-adaptive internal flow control device is in a float-type, and controls an opening degree of a buoy according to the change in viscosity of different fluids so as to automatically limit flow.

3. The composite water-controlling screen pipe according to claim 2, wherein the self-adaptive internal flow control device is made of tungsten carbide hard alloy.

4. The composite water-controlling screen pipe according to claim 1, 2 or 3, wherein the flow control device comprises:

a support diversion disc opened with an overflow groove and a diversion pipe; and

a rotatable balance disc connected to the support diversion disc and provided with a throttle hole to cooperate with the overflow groove and the diversion pipe, the balance disc being rotated as needed to regulate the number of plugged holes of the throttle hole to control the overflow of the base pipe, and being locked with a lock nut.

5. The composite water-controlling screen pipe according to claim 4, wherein the throttle hole is mounted with a tungsten alloy nozzle.

6. The composite water-controlling screen pipe according to claim 1, 2, 3 or 5, wherein the screen pipe comprises:

a body; and

a filter sleeve comprising an outer protective jacket, a filter jacket and an inner protective jacket fitted sequentially, the filter jacket comprising a plurality of filter screens stacked successively, wherein hole sizes of the filter screens are set depending on requirement for oil reservoir.

7. The composite water-controlling screen pipe according to claim 6, wherein the inner protective jacket, the outer protective jacket and the filter screen are all made of acid-proof and antiseptic materials.

8. The composite water-controlling screen pipe according to claim 7, wherein both ends of the filter sleeve are respectively welded to the flow control device and a positioning step of the body, and fluid flowing through the filter screen flows into the base pipe via the self-adaptive internal flow control device after passing through the flow control device.

9. The composite water-controlling screen pipe according to claim 6, wherein the filter sleeve is fixed onto the body via a support disc.

10. A composite water-controlling and flow-limiting device, comprising a composite water-controlling screen pipe according to any one of claims 1-9.