

[54] **RUNNING-IN TOOL FOR WELLS**
[72] Inventors: **Gary A. Radig**, Lakewood; **Oliva A. Rowell, Jr.**, Long Beach, both of Calif.; **Harvey R. Edwards**, Beirut, Lebanon
[73] Assignee: **Cook Testing Co.**, Long Beach, Calif.
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[52] U.S. Cl. **166/214**
[51] Int. Cl. **E21b 23/00**
[58] Field of Search **166/206, 214**

[56]

References Cited

UNITED STATES PATENTS

2,871,947	2/1959	Fredd	166/214
2,908,333	10/1959	Schwab	166/206
3,073,392	1/1963	Dinning et al	166/214
3,507,329	4/1970	Stone, Jr.....	166/214

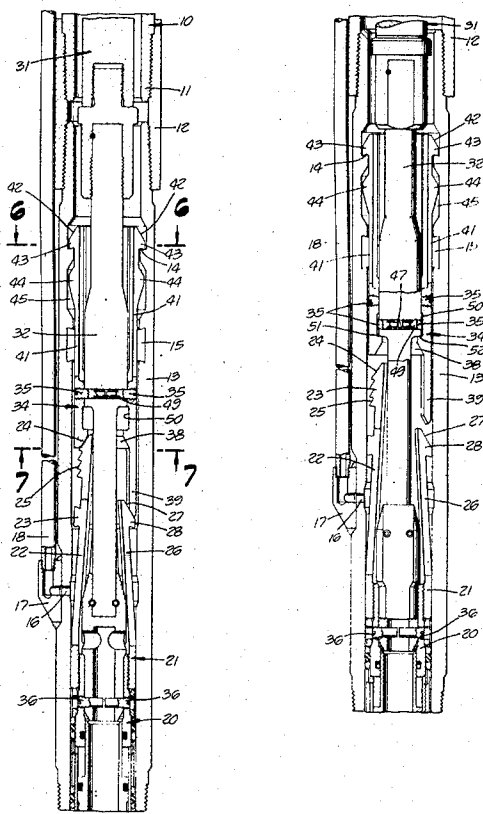
FOREIGN PATENTS OR APPLICATIONS

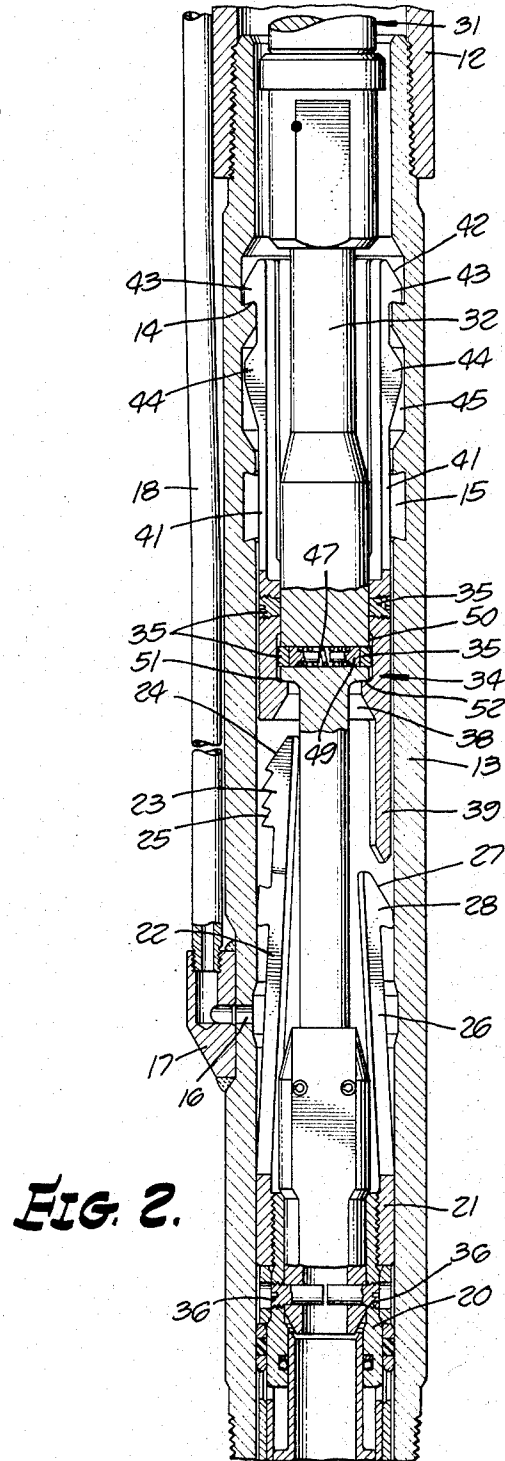
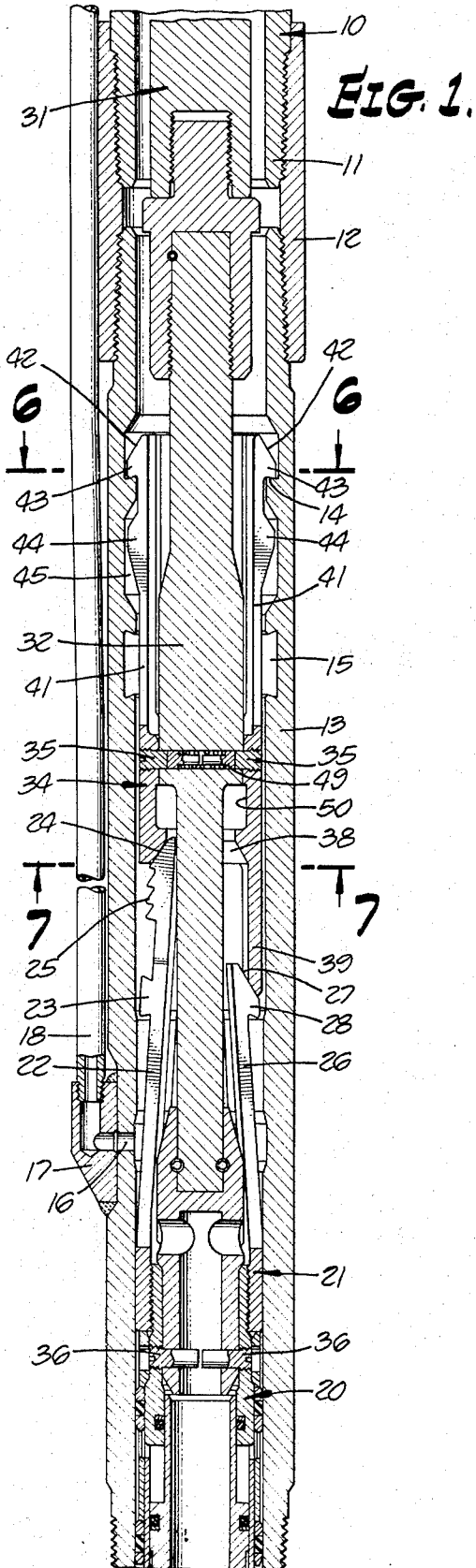
676,042	12/1963	Canada.....	166/206
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Primary Examiner—James A. Leppink
Attorney—Lyon & Lyon

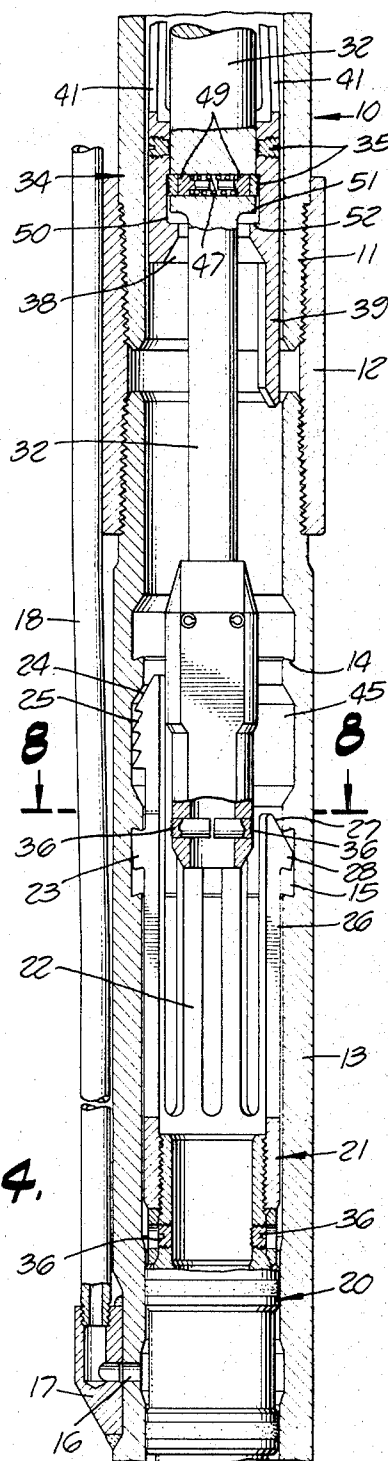
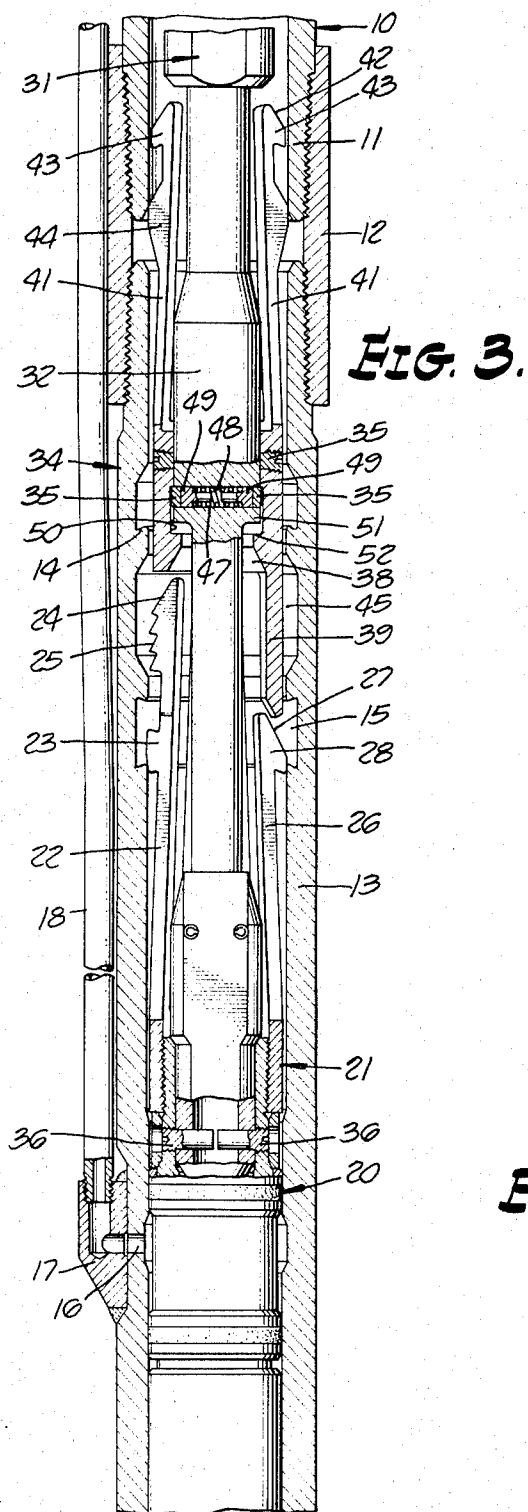
[57] **ABSTRACT**
A running-in tool for placing a flow control device in a section of a pipe installed in a well comprises a carrier connected by shear pins to the flow control device and adapted to be lowered into the well pipe, together with a collet encircling a portion of the carrier and connected thereto by additional shear pins. The collet is provided with a series of axially extending spring fingers each having a portion adapted to engage an internal shoulder provided in the well pipe. The flow control device also has axially extending spring fingers for engagement with an internal recess in the well pipe. The collet has an inverted tapered bowl proportioned to receive the upper end of most of the spring fingers of the flow control device to hold them in a retracted inoperative position, the remaining spring fingers being shorter and held in the inoperative position by posts on the collet extending below the bowl.

8 Claims, 8 Drawing Figures





INVENTORS.
 GARY A. RADIG
 CLIVA A. POWELL, JR.
 BY HARVEY R. EDWARDS
Hyon & Hyon
 ATTORNEYS



INVENTORS.
 GARY A. RADIG
 CLIVA A. ROWELL, JR.
 BY HARVEY R. EDWARDS
Hyatt Hyatt
 ATTORNEYS

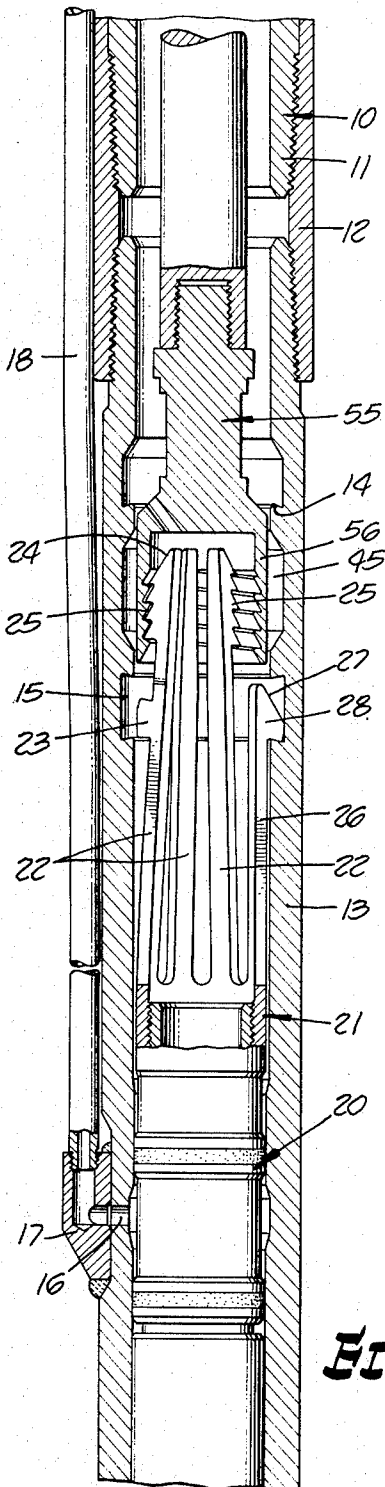


FIG. 5.

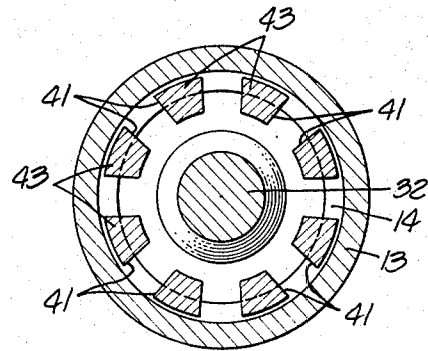


FIG. 6.

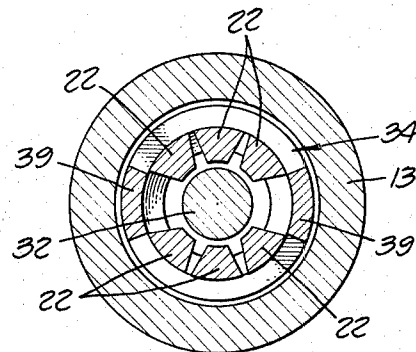


FIG. 7.

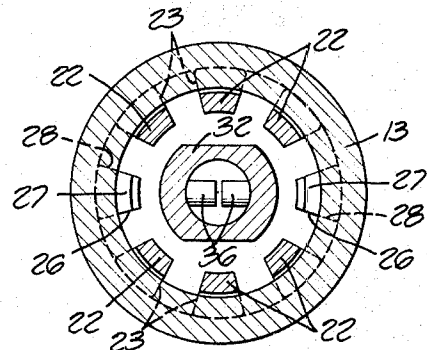


FIG. 8.

INVENTORS.
GARY A. RADIG
CLIVA A. ROWELL, JR.
BY HARVEY R. EDWARDS

Hyoun & Hyoun
ATTORNEYS

RUNNING-IN TOOL FOR WELLS

This invention relates to well tools and is particularly directed to a running-in tool for placing a flow control device, such as a valve assembly, at a predetermined location in a pipe installed in a well. As an example, such a running-in tool may be employed on a wire line for lowering a valve assembly through a string of tubing installed in the well to anchor it at a predetermined location in the tubing, and then to permit disconnection so that the running-in tool may be withdrawn upward out of the tubing. Subsequently, the valve assembly may be removed from the well, if desired, by an overshot type of tool which first releases the anchoring connection and is then employed to lift the valve assembly out of the tubing.

Conventional running-in tools for placing a flow control device, such as a valve assembly, in a predetermined position in a well tubing have been used in connection with an anchoring device attached to the valve assembly, which anchoring device engages an internal recess in a particular section of the well tubing placed at the desired level in the well. Downward movement of the valve assembly ceases when the anchoring device engages the internal recess in the tubing, and further downward movement of the running-in tool shears the pins which attach it to the valve assembly. The running-in tool is then withdrawn upwardly to the surface, leaving the valve assembly anchored in place.

A difficulty arises in such conventional practice when it is desired to withdraw the valve assembly from its position on the well, because the retrieval tool must first release the anchoring device and then be able to lift the valve assembly out of the tubing string. The anchoring device commonly comprises a circular series of spring fingers which move outward to engage the internal recess in the tubing. A retrieval tool of the overshot type must retract the spring fingers radially inward from their engagement with the recess and at the same time develop a connection to the spring fingers sufficiently reliable to withdraw the valve assembly from the tubing. In actual practice, it has been found that withdrawal of the valve assembly may be hindered by release of the spring fingers of the anchor device before the retrieval tool obtains an adequate grip upon them, with the result that the anchor device is released but the valve assembly is simply pushed down through the tubing by failure of the retrieval tool to complete its connection to the valve assembly for lifting it upward.

A feature of the present invention is to prevent unwanted downward movement of the valve assembly during the retrieval operation and to insure that the anchor device does not release until after the retrieval tool is solidly connected to withdraw the valve assembly. This in turn requires a modification of the anchoring device, and this invention is directed to an improved form of running-in tool for setting such anchoring device in well tubing.

In the drawings;

FIG. 1 is a sectional side elevation showing the parts at the end of the running-in operation.

FIG. 2 is a sectional view similar to FIG. 1, the carrier and flow control device having been moved downward with respect to the collet.

FIG. 3 is a similar view of the carrier, collet and flow control device having been moved upward almost to anchored position.

FIG. 4 is a similar view showing the carrier and collet being lifted out of the well pipe following fracture of the shear pins connecting the carrier to the flow control device.

FIG. 5 is a sectional side elevation showing the flow control device in position in the well pipe, and showing the action of a retrieval tool for disconnecting the flow control device from the well pipe and subsequently lifting the flow control device back to the surface.

FIGS. 6 and 7 are transverse sectional views taken substantially on the lines 6—6 and 7—7, respectively, as shown in FIG. 1.

FIG. 8 is a transverse sectional view taken substantially on the lines 8—8 as shown in FIG. 4.

Referring to the drawings, the well pipe or tubing string generally designated 10 comprises a plurality of sections 11 connected end-to-end by threaded couplings 12. One of the tubing sections 13 is provided with an internal downward facing shoulder 14 and an internal annular recess 15. The tubing section 13 is also provided with a side port 16 communicating by way of fitting 17 with the lower end of a control pipe 18.

A flow control device generally designated 20 may comprise a valve assembly of any suitable or desirable type. One form of such valve assembly is shown in the copending application of Gary A. Radig, Ser. No. 110,078 filed Jan. 27, 1971, and entitled "Rotary Ball Valve for Wells". This flow control device 20 is provided with anchor means generally designated 21 and including a series of spring fingers 22 each having a lug 23 fixed thereon. The upper end of each spring finger 22 is bevelled at an angle as shown at 24, and each spring finger has an outer serrated portion 25. Two spring fingers 26 are shorter than the others. Their upper ends are bevelled as shown at 27, and each is provided with a lug 28.

A running-in tool generally designated 31 may be lowered into the tubing 10 on a wire line (not shown), and this tool includes a carrier 32 and a collet 34 encircling a portion of the carrier. Shear pins 35 connect the carrier to the collet and shear pins 36 connect the carrier to the flow control device 20. The collet 34 has an inverted bowl 38 shaped to receive the bevelled upper ends of the spring fingers 22 and to hold them in a radially retracted inoperative position. Downward extending posts 39 on the collet 34 project below the bowl 38 and contact the upper bevelled ends of the short spring fingers 26 to hold them in retracted inoperative position. Another series of spring fingers 41 is provided on the collet 34. These spring fingers 41 are duplicates and each is provided with a tapered upper end 42, a lug 43 for contact with the shoulder 14, and a bridging fin 44 adapted to be received in the clearance space 45 in the tubing section 13.

The running-in tool 31 and the flow control device 20 are connected, as shown in FIG. 1 of the drawings, and are lowered into the tubing 10 on a wire line. The spring fingers 22 and 26 remain in a retracted inoperative position and hence do not contact the interior of the tubing 10. The spring fingers 41 on the collet 34, however, drag through the interior of the tubing 10, but the lugs 43 are prevented from hanging up in the recesses between ends of adjacent tubing section by means of the bridging fins 44. When the spring fingers 41 on the collet reach the tubing section 13, the lugs 43

expand radially outward and engage the shoulder 14. The clearance recess 45 provides clearance for the bridging fins 44. Downward movement of the collet 34 is arrested when the lugs 43 engage the shoulder 14. The parts are then in the position shown in FIG. 1 of the drawings.

Downward force is then applied by jars (not shown) to move the carrier 32 downward to shear the pins 35 and move the flow control device 20 to the position shown in FIG. 2. In this position the spring fingers 22 are released from the bowl 38 and the spring fingers 26 are released from the downward extending posts 39; the lugs 23 and 28 spring radially outward into engagement with the inner surface of the tubing section 13.

Transverse coil spring 47 mounted in bore 48 in the carrier 32 acts on opposite ends against followers 49 to push the fractured inner ends of the shear pins 35 into contact with the inner surface 50 of the collet 34. This prevents any substantial upward movement of the carrier 32 with respect to the collet 34. Downward movement of the carrier 32 with respect to the collet 34 is limited by engagement of the shoulder 51 on the carrier 32 with the abutment 52 on the collet 34.

After the spring fingers 22 and 26 have been released to move outward into contact with the interior surface of the tubing section 13, as shown in FIG. 2, the carrier 32 is raised to lift the flow control device 20 until the lugs 23 on the spring fingers 22 and the lugs 28 on the spring fingers 26 all engage within the internal recess 15 in the tubing section 13. During this lifting operation, the spring fingers 41 on the collet 34 slide upward within the tubing 10 because the bevelled surfaces 42 slide over obstructions within the tubing and deflect the spring fingers 41 radially inward.

When the lugs 23 and 28 are seated within the recess 15, the flow control device 20 is anchored within the tubing 10 at the desired elevation. The running-in tool 31 is then lifted upward to shear the pins 36 connecting it to the flow control device 20. The running-in tool 31, including the carrier 32 and collet 34, is then lifted upward out of the tubing, leaving the flow control device 20 anchored in place. The position of the parts just after shearing of the pins 36 is shown in FIG. 4.

If for any reason it should be desired to remove the flow control device 20 from the tubing 10, an overshot retrieval tool 55, as shown in FIG. 5, is lowered into the tubing 10 on a wire line. This retrieval tool 55 has an internally serrated socket 56 at its lower end, and the socket is open at the bottom. Downward jarring movement of the retrieval tool 55 causes the socket 56 to be telescoped over the upper serrated ends of the spring fingers 22, thereby moving them radially inward to retract the lugs 23 out of the recess 15. However, the socket 56 does not engage the short spring fingers 26, and these continue to offer resistance to downward movement of the flow control device 20 by reason of engagement of the lugs 28 with the lower edge of the recess 15. Thus, the retrieval tool 55 may be jarred to insure full entry of the upper ends of the spring fingers 22 into the socket 56 without danger of driving the flow control device 20 down the interior of the tubing 10. When the socket 56 has telescoped completely over the upper ends of the spring fingers 22, the connection between the retrieval tool 55 and flow control device 20 has been completed. The retrieval tool 55 is then

lifted upward and the bevelled surfaces 27 on the two short spring fingers 26 slide over obstructions on the way out of the tubing.

Having fully described our invention, it is to be understood that we are not to be limited to the details herein set forth but that our invention is of the full scope of the appended claims.

We claim:

1. In a running-in tool for placing a flow control device in a section of a pipe installed in a well, the pipe section having an upward facing internal shoulder and an axially spaced internal recess, the improvement comprising, in combination: a collet having a plurality of axially extending spring fingers, each of the spring fingers having a portion thereof adapted to engage and rest on the shoulder, a carrier extending through the interior of the collet, an abutment on the carrier underlying a portion of the collet, second releasable means connecting the carrier to the flow control device for engagement with the recess in the pipe section, means on the collet for maintaining the expansible support means in retracted inoperative position while lowering the carrier, collet and flow control device into position in the well pipe, whereby downward movement of the collet is arrested by engagement of the spring finger portions with the shoulder so that continued downward movement of the carrier releases said first releasable means, and disengages the expansible support means from said collet, subsequent upward movement of the carrier serving to lift the flow control device to permit said expansible support means to engage within the recess in the pipe section, and continued upward movement of the carrier serving to release said second releasable means and permit upward withdrawal of the running-in tool from the well pipe.

2. The combination set forth in claim 1 in which the said first releasable means comprises a plurality of radially extending shear pins each fixed on the collet and spring-loaded radially outwardly on said carrier.

3. In a running-in tool for placing a flow control device in a section of a pipe installed in a well, the pipe section having an upward facing internal shoulder and an axially spaced internal recess, the improvement comprising, in combination: a collet having a plurality of upward extending spring fingers, each of the spring fingers having a lug adapted to engage and rest on the shoulder in the pipe section, a carrier extending through the interior of the collet, an abutment on the carrier underlying a portion of the collet, first frangible means connecting the carrier to the collet, second frangible means connecting the carrier to the flow control device, expansible support means on the flow control device for engagement with the recess in the pipe section, means on the collet for maintaining the expansible support means in retracted inoperative position while lowering the carrier, collet and flow control device into position in the well pipe, whereby downward movement of the collet is arrested by engagement of the lugs with the shoulder so that continued downward movement of the carrier breaks said first frangible means and releases the expansible support means from said collet, subsequent upward movement of the carrier serving to lift the flow control

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device to permit said expansible support means to engage within the recess in the pipe section, and continued upward movement of the carrier serving to break said second frangible means and permit withdrawal of the running-in tool upward from the well pipe.

4. The combination set forth in claim 3 in which the expansible support means includes a circular series of spring fingers each having a lug portion engageable within the recess, certain of said spring fingers in said series extending axially beyond their respective lug portions, the collet having an inverted tapered bowl for confining the extending portions of said spring fingers in said retracted inoperative position, and downward projecting elements on said collet extending below said inverted bowl for contacting and maintaining certain others of said spring fingers in said retracted inoperative position.

5. In a running-in tool for placing a flow control device in a section of a pipe installed in a well, the pipe section having an upward facing internal shoulder, the improvement comprising, in combination: a collet having a plurality of upward extending spring fingers, each of the spring fingers having a lug adapted to engage and rest on the shoulder in the pipe section, a carrier extending through the interior of the collet, an abutment on the carrier underlying a portion of the collet, first frangible means connecting the carrier to the collet, second frangible means connecting the carrier to the flow control device, expansible support means on the flow control device for engagement within the well pipe, means on the collet for maintaining the expansible support means in retracted inoperative position

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while lowering the carrier, collet and flow control device into position in the well pipe, downward movement of the collet being arrested by engagement of the lugs with the shoulder, and continued downward movement of the carrier serving to break said first frangible means and to release the expansible support means from said collet, subsequent upward movement of the carrier serving lift the flow control device to permit its expansible support means to engage within the well pipe, and continue upward movement of the carrier serving to break said second frangible means and permit withdrawal of the running-in tool upward from the well pipe.

6. In a running-in tool for placing a flow control device in a section of pipe installed in a well, the pipe having an upward facing internal shoulder, the subcombination of: a carrier adapted to be lowered into the well pipe, means whereby the carrier may be releasably secured to a flow control device, a collet encircling a portion of the carrier and having a series of axially extending spring fingers each having a portion adapted to engage the internal shoulder, means for releasably connecting said carrier to said collet, said collet having an inverted tapered bowl below said spring fingers, said bowl being proportioned to receive upper ends of similar spring fingers carrier upon the flow control device to hole them in a retracted inoperative position.

7. The subcombination set forth in claim 6 in which frangible means connect the carrier to the collet.

8. The subcombination set forth in claim 6 in which frangible means are provided for connecting the carrier to the flow control device.

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