Aug. 3, 1965 W. G. OWNBY 3,198,255

MAGNETIC SIGNALING WELL TUBING NIPPLE

Original Filed April 19, 1961

Fig. 1

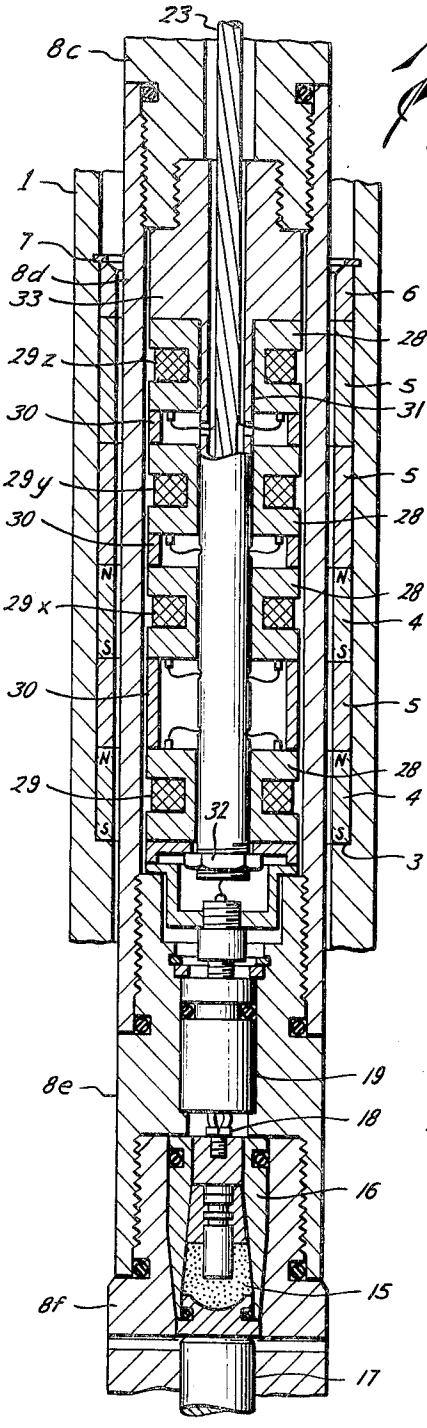


Fig. 2

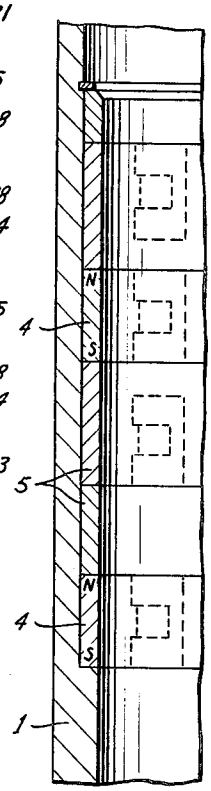
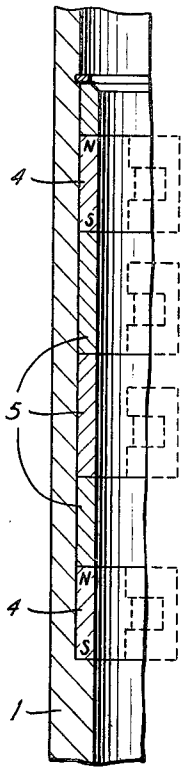


Fig. 3



W. G. Ownby
INVENTOR.

BY G. C. Helmig

ATTORNEY

United States Patent Office

3,198,255

Patented Aug. 3, 1965

3,198,255

MAGNETIC SIGNALING WELL TUBING NIPPLE

Warren G. Ownby, Houston, Tex., assignor to Camco, Incorporated, Houston, Tex., a corporation of Texas

Original application Apr. 19, 1961, Ser. No. 104,051. Divided and this application Feb. 17, 1964, Ser. No. 345,316

1 Claim. (Cl. 166—65)

This invention relates to well working equipment and more particularly to the signaling of work at a selected depth in a well hole.

This application is a division of copending application S.N. 104,051, filed April 19, 1961, disclosing a self contained tool which is triggered into action by electromotive force generated by tool travel through a signaling field. A signaling field is provided at one or more downhole stations within a well tubing string assembly. Each station involves a magnetic field protruding inwardly from the tubing wall for effecting response of a tool carried field influenced component presented to the magnetic field.

An object of the invention is to provide a tubing string having a number of spaced apart signaling stations, each comprising a pair of magnetic fields differently spaced apart in each station and for co-operation with a running tool having transducers to be influenced upon traverse of a selected station for directing bias voltage to a pair of circuit controlling semiconductor rectifiers.

A further object is to provide an improved tubing string signaling marker comprising a tubing section of nonmagnetic material interiorly faced by a stack of co-operating rings certain of which are longitudinally spaced apart permanent magnets having their opposite poles axially spaced apart and providing inwardly protruding fields to be traversed by similarly spaced apart field detectors of a subsurface tool for signaling tool actuation.

Additional objects and advantages will become apparent from the accompanying drawing, wherein

FIG. 1 is a fragmentary view of a tubing string and co-operating running tool in vertical section; and

FIGS. 2 and 3 are vertical sections of fragments of the tubing sections at different signaling stations.

Referring to FIG. 1, a portion of a wire line running tool for electrically controlling an operation is illustrated and the operation to be controlled may be considered as the setting of a latch unit in any one of a number of receivers in a tubing string and in response to moving traverse of a set of spaced apart transducers through a pair of magnetic fields positioned by the tubing string adjacent the predetermined receiver and in a spaced apart relation different from the fields at other receivers and to which distinctive spaced relation the transducer spacing has been coded or matched by a preset selective combination of a particular pair of running tool carried transducers.

As herein shown, the tubing string section or nipple **1** has an upper counterbore or pocket ending at a bottom shoulder **3**. The wall of the nipple is of brass or other suitable nonmagnetic material and has fitted within it an end to end succession or stack of rings seated downwardly on the shoulder **3** and preferably of the same internal diameter as the main bore of the nipple. Included in the stack are a set of two permanent magnet rings **4** and three nonmagnetic spacer rings **5** togther with a top nonmagnetic ring **6** for retentive bearing co-operation with a spring expander ring **7** for a removable snap fit into a co-operating groove in the nipple wall. Rings of the same or of different lengths can be employed but in any event the magnet rings and the spacer rings **4** and **5** respectively are interchangeable as to their successive relationship for obtaining diverse spacing between the upper and lower magnet rings, as will be appreciated by a comparison of FIGS. 1, 2 and 3. While the number of different magnet space relations can be varied and a greater number of spacer rings can be employed, it is to be expected that a well tubing string will ordinarily require latch receivers at no more than three locations and the variance in magnet spacing as illustrated will afford distinctive signals at three stations. In each instance, the lower magnet ring is retained at the bottom of the stack for simplifying the arrangement of magnet influenced elements of the running tool.

For co-operatively influencing the running tool transducers, as will later be more apparent, each magnet ring **4** is magnetized longitudinally and has its opposite poles at the top and bottom edges of the ring. With the north pole at the annular upper end, the field within and throughout the ring circle will protrude radially inwardly of the tubing string and the lines of force will run in a general longitudinal direction from the upper north pole to the bottom south pole. When any such field is traversed by a transducer, an output electromotive force will be induced but only when the spacing of a pair of transducers is coded or matched with the spacing of a particular pair of fields will both transducers be influenced simultaneously for signaling the performance of a desired operation.

For response selectively to any one and not others of the several tubing string stations, a wire line running tool as disclosed in the aforementioned patent application, is employed. Such tool has operating components to be selectively actuated when a circuit is completed through a pair of semiconductor rectifiers supplied with bias voltage upon concurrent passage by a selected pair from a group of transducers, through magnetic fields of a given signaling station. Thus the body of the tool includes a coupler nipple **8***c*, an intermediae nonmagnetic housing tube **8***d*, a coupler nipple **8***e* and a bottom section **8***f*. Housed within the bottom section is a cartridge shell **16** containing a combustible charge **15** which when fired furnishes expanding gas pressure to act on and depress a slide plunger **17** for a latch setting operation. The charge **15** is ignited by an electrically actuated detonator in a control circuit having one side grounded through the body and the other side joined to a connector plug **18** and a socket connector **19**. The circuit is completed through a pair of semiconductor rectifiers, one of which receives bias voltage generated at the coil **29** and the other of which receives bias voltage generated at the coils **29***x*, **29***y* and **29***z* and delivered from any such coil through a selector switch. Conductor wires joining the electrical components are grouped as a bundle **23**.

The several coils are motional electromotive force detectors and are housed within the nonmagnetic body section **8***d* in longitudinally spaced apart succession so predetermined that any two detectors can be aligned radially with the circular magnets in the optional space settings illustrated in FIGS. 1, 2 and 3. Each detector comprises a spool **28** of high magnetic permeable material wound with many turns of insulated conducting wire. The several spools **28**, held apart by tubular spacers **30**, are sleeved on a hollow spindle or stud **31**. A washer and a retainer nut **32** secure the spools against the stud head **33**, which in turn is threaded into the coupler **8***c*. The coil **29** can be paired with any one of the coils **29***x*, **29***y* and **29***z* through selector switch adjustment. The spaced apart relations of the coils in the three pairings will correspond to the spacing of the magnet rings shown in FIGS. 1, 2 and 3 respectively. By preselection of any pair of coils, a coded or matched relationship with the field spacing at any particular signaling station is obtained.

As each coil of a selected pair passes through any field during tool descent, an electromotive force will be directed to the semiconductor coupled to that particular

coil. Such bias voltage conditions the semiconductor for the passage of battery current but unless both semiconductors are conditioned to pass current at the same time, the battery or firing circuit remains closed. Simultaneous travel of both coils of a selected pair through the pair of fields at a tubing station to which the coils have been coded, delivers bias voltage to both series connected semiconductors for a switch-on of current for detonating or releasing the work performing energy provided by the squib assembly.

Modifications in the structure as specifically described can be made without departing from the invention as set out in the appended claim.

What is claimed is:

For providing a signal marker in a tubing, a tubing element of nonmagnetic material and a stack of rings fitted in interchangeable succession within the tubing element, certain of said rings being magnetized in the axial direction thereof and each of like polarity throughout its circular extent with opposite poles at opposite ends thereof and others of the rings being of nonmagnetic material and of lengths differing axially one from another, said others of the rings in interchangeable relation being interposed between the magnetized rings for locating the latter selectively in longitudinally spaced apart relationships.

References Cited by the Examiner

UNITED STATES PATENTS

2,350,832	6/44	Segesman	166—66 X
2,830,663	4/58	Kirby	166—65
2,895,092	7/59	Cluwen	317—159 X
2,906,929	9/59	Wyckoff	317—201
2,953,970	9/60	Maynard	317—159 X
2,983,840	5/61	Van Iperen	317—201 X
3,105,547	10/63	Ownby	166—65
3,105,548	10/63	Ownby	166—65
3,105,551	10/63	Ehlert	166—65
3,106,960	10/63	Doak	166—66

CHARLES E. O'CONNELL, *Primary Examiner.*