

July 20, 1965

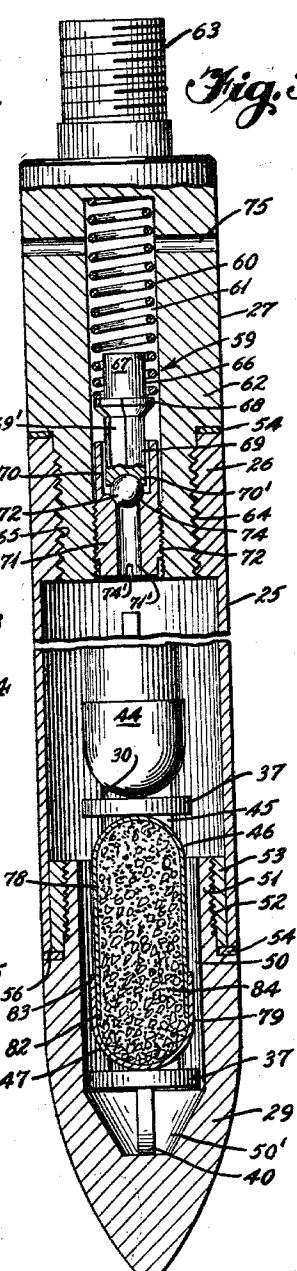
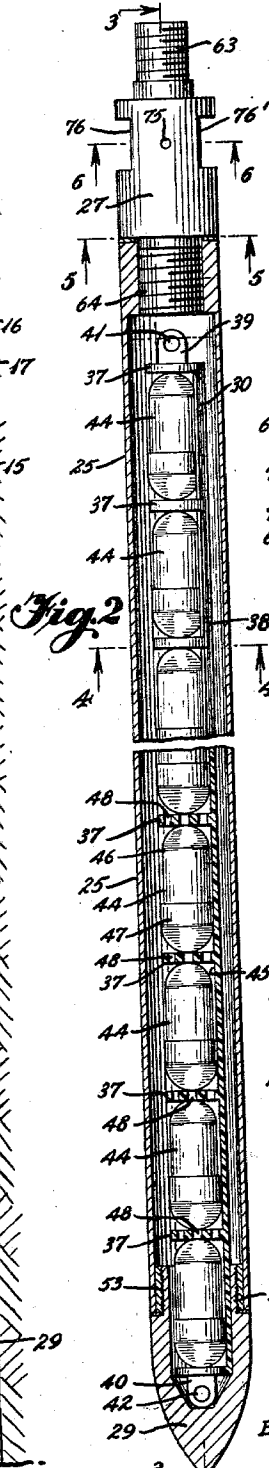
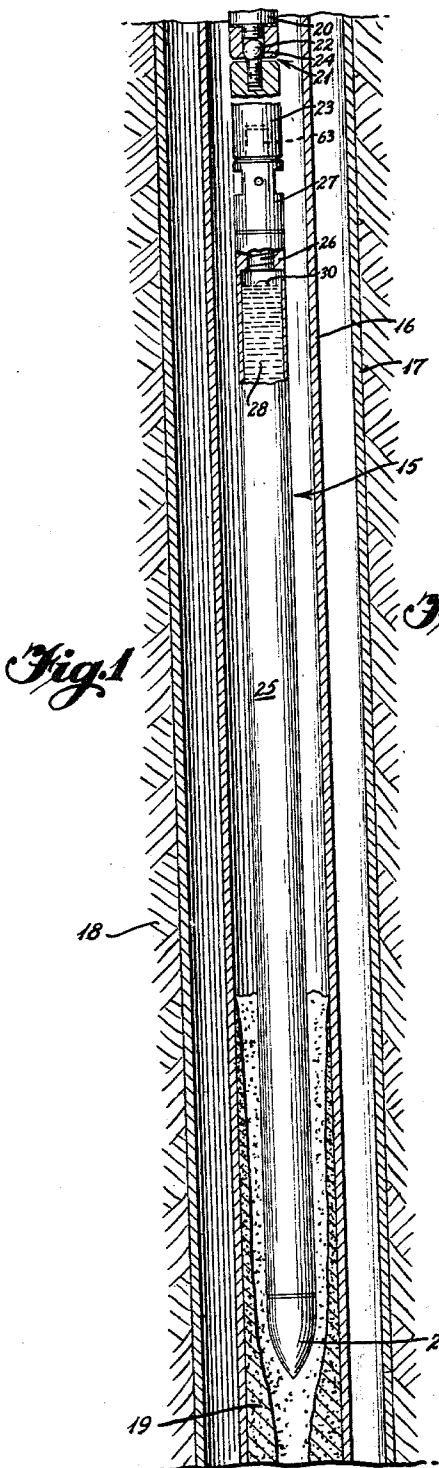
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CHEMICALLY HEATED TOOL FOR REMOVAL OF PARAFFIN

Filed Nov. 15, 1960

2 Sheets-Sheet 1



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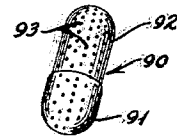
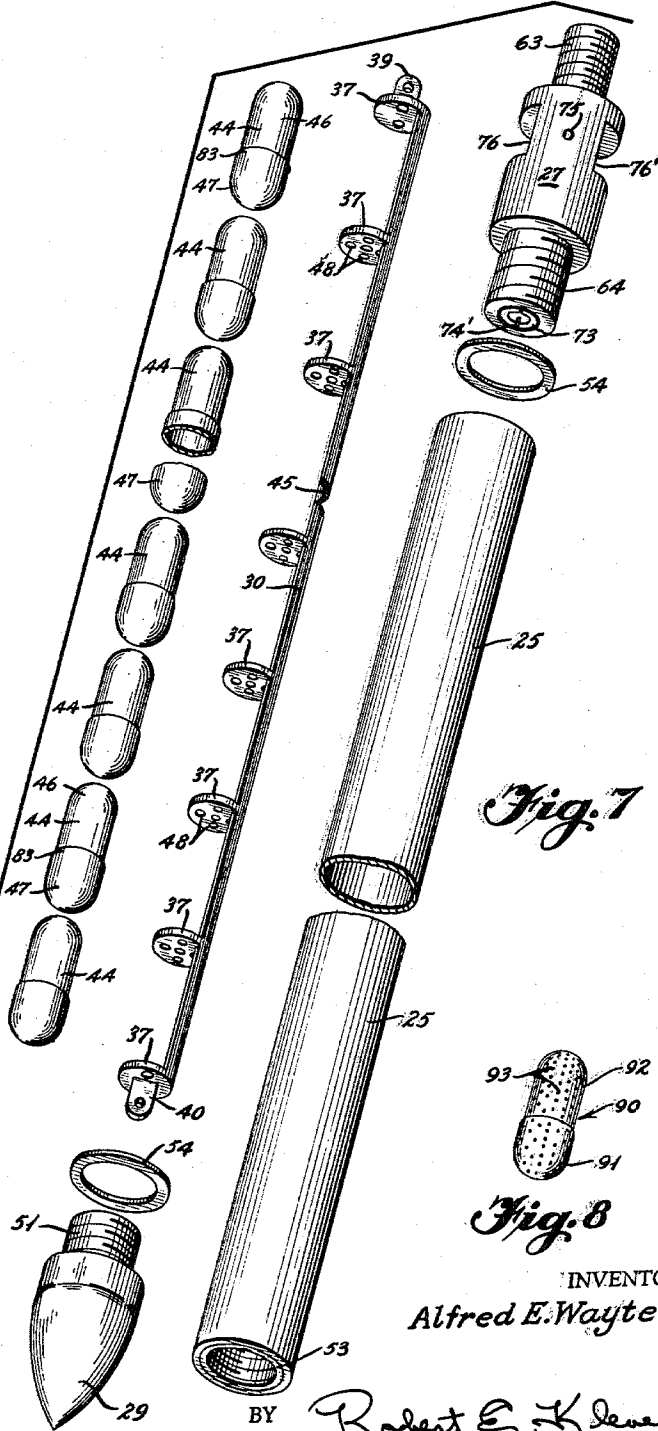
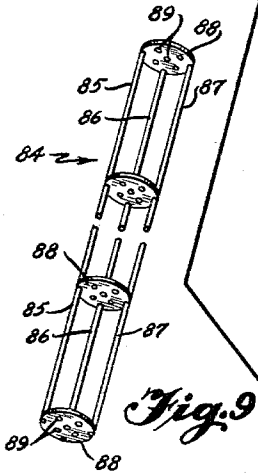
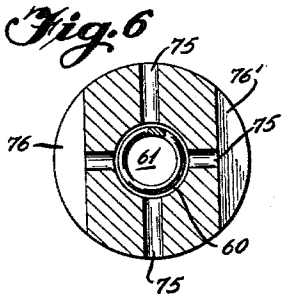
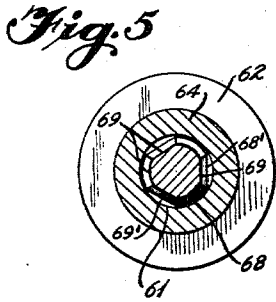
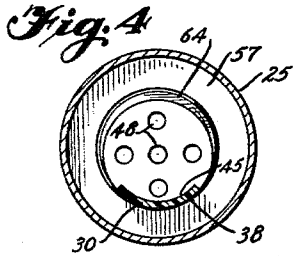
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CHEMICALLY HEATED TOOL FOR REMOVAL OF PARAFFIN

Filed Nov. 15, 1960

2 Sheets-Sheet 2



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CHEMICALLY HEATED TOOL FOR REMOVAL OF PARAFFIN

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10 Claims. (Cl. 166—58)

This invention relates to chemical heating equipment, more particularly to chemical heating tools, processes, and apparatus employed in oil wells in heat treating the oil well tubing to melt and remove paraffin, asphaltic deposits and other heat soluble hydrocarbons which tend to build up and coagulate and harden along the inner diameter of the oil well tubing during the pumping of oil therethrough, and restrict or block the flow of oil through the tubing, and otherwise clog or tend to interfere with the oil flow or regular pumping operation.

In the past, a numerous variety of heating tools and systems, both of a chemical and electrical nature, have been suggested and employed by the crude oil industry, to create and produce heat at elevated temperatures within the oil well, at the situs, and cause melting of the paraffin accumulating therein, however, none of these devices have proved entirely satisfactory.

Many heating devices or systems either necessitated the presence of expensive operating equipment at the surface in conjunction with the heat treatment within the well, in order to satisfactorily perform the melting operation, and/or because of various shortcomings in the manner of applying the heat treatment or in the structural operation of the heat tool or device per se; the overall heat treating operation became expensive and time consuming resulting in costly interruptions in the regular oil pumping operation.

For example, in many instances, the prior chemical heat tools or systems, to which field the present invention is primarily concerned, have been systems of simply pouring the chemicals into the well and thereafter flushing the well to remove the chemicals from the tubing, as well as the melted paraffin. The systems have been largely inefficient for a number of reasons, among them being that some of the chemicals in falling into the well would cling along portions of the tubing where paraffin and other accumulations had not occurred.

Some other chemical devices consisted of containers of chemicals being dropped to the bottom of the oil well, where they were to react with any water present at the bottom of the oil well, and produce turbulence and heat for melting the paraffin solidified in the vicinity thereof. These devices, however, generally had to rely upon the presence of water at the bottom well, if the chemical reaction was to take place, however, because of the respective densities of water and oil, and other factors, and also because of the different characteristics of each well, there was no assurance that water would be present, particularly along the upper regions of the well tubing in sufficient quantity to provide an adequate heat producing reaction with the chemicals. As a result, in many cases, water was added to the well. This in itself was a time consuming and costly operation.

While certain other previous chemical devices, provided the chemical and its reacting fluid within the tool, with mechanism allowing the chemical to be released and to gravitate in the chamber space where it could contact the chemical and produce the chemical heat reaction, however, these would have been objectionable in many instances because involved operating mechanism as well as other elaborate structure, also because of their method of handling the chemicals and fluids, many of these have been dangerous to the oil crew. Moreover, some have

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not produced a chemical reaction in a manner as to be most effective in the heat treatment of the well.

It is an object of this invention to overcome the aforementioned deficiencies and shortcomings and to provide a novel chemically heated tool, which may be handled with improved safety to the crewman operating the tool, and which when lowered into the well provides an improved more uniform heating of the tool for more rapid and effective melting of the paraffin and other materials within the oil well tubing.

It is a further object of the invention to provide a chemical tool having a single chamber with both the chemical and liquid in the single chamber and with the chemicals and enclosed in a capsule which will dissolve after an interval of time, to enable the chemical and water to contact each other and produce the chemical heat reaction in the chamber.

It is a further object of the invention to provide a novel chemical tool which includes a plurality of chemical capsules extending along substantially the entire length of the heat chamber of the tool, so as to provide a more effective and uniform heat radiation against oil well tubing.

It is a further object of the invention to provide a novel chemical tool having the chemical extending centrally along the length of the chamber of the tool, and fluid annularly surrounding the chemical to produce a more efficient heat producing chemical reaction, and facilitate loading of the tool with its chemical and fluid.

It is another object of the invention to provide a novel chemical tool, wherein the chemicals are enclosed in gelatin capsules and which will dissolve upon contact with the fluid, only after sufficient time has elapsed to enable the fluid to be introduced or added into the tool, and the tool capped, and inserted into the well.

It is another object of the invention to provide a novel and improved chemically heated paraffin remover tool wherein the chemical heat reaction takes place within the tool automatically after a time delay sufficient to charge the tool with its fluid and reacting chemicals.

It is a further object to provide a chemical tool with improved heating characteristics and with a simplified, inexpensive construction and operation.

It is another object of the invention to provide a novel chemical tool which provides for simultaneous heating along the length of the tool, and including means to reduce the setting of the chemicals during the heat reaction, so as to prevent localization of the chemical reaction into small areas with respect to the tool.

It is a further object of the invention to provide a novel chemical tool which the chemical is located centrally of the tool and the fluid to react with the chemical is located circumferential so that the chemical reaction begins to take place along the outside of the chemical, thereby locating the place of the turbulent chemical reaction adjacent the outer sleeve of the tool.

It is a further object of the invention to provide a means for encasing the chemicals, so that the chemicals may be loaded into the heating tool without possible contact of the chemical by the crewman.

It is another object of the invention to provide an improved method of assembling a chemical tool as well as utilizing the same for heat treating oil well tubing, whereby there is little danger of the crew, conducting the operation, coming into physical contact with the chemical or the chemical reaction.

Further objects and advantages will become apparent as the description proceeds and when taken in conjunction with the drawings wherein:

FIG. 1 is a side elevation of the chemical tool invention suspended in operative position with the tubing of an oil well, with the oil well tubing having a slightly

enlarged diameter with respect to the tool, for clarity.

FIG. 2 is a side view of the chemical tool, slightly enlarged and with portions cut away along the length thereof to reveal the details of the interior construction of tool to and disclosing the gelatin chemical capsules mounted in a rack member, extends along the length of the tool.

FIG. 3 is a further enlarged longitudinal cross-sectional view of the chemical tool, disclosing the details of the pressure release valve mechanism, and the detailed structure of the nose cone assembly mounted to the lower end of the tool and a cutaway view of one of the gelatin capsules, revealing the chemical materials therein.

FIG. 4 is a lateral cross-sectional view taken along line 4-4 of FIG. 2, disclosing the rack member and one of the capsule spacers, mounted in the central position within the chemical tool.

FIG. 5 is a lateral cross-sectional view taken along line 5-5 of FIG. 2 illustrating the construction of the plunger member of the pressure release valve mechanism in the plug element.

FIG. 6 is a lateral cross-sectional view taken along line 6-6 of FIG. 2 disclosing the release ports or ducts of the pressure release valve mechanism.

FIG. 7 is an exploded view, in perspective, of the chemical tool invention.

FIG. 8 is a perspective of a modified form of capsule.

FIG. 9 is a perspective view of a modified capsule holder or rack member.

Briefly stated, the invention is a chemically heated tool for melting paraffin from oil tubing and lines, the chemical tool invention is elongated and bullet-like in shape and has a single elongated heat chamber in the form of a cylindrical sleeve which extends nearly the entire length of the chemical tool and the single heat chamber or sleeve holds the chemicals and liquid for producing the chemical heat reaction. The tool also has detachable cap members closing the remote end of the heat chamber or sleeve.

The invention further includes a plurality of chemical capsules positioned in a row centrally along the longitudinal axis of the heat chamber, and extending substantially the entire length of the heat chamber, a rack member removably mounted centrally within the heat chamber for loading and positioning the chemical capsules in the central position in the chamber.

The invention also includes the heat chamber being larger in diameter than the chemical capsule to provide an annular space within the chamber around the capsule, and throughout the length of the chamber, with liquid filling the annular space surrounding the capsules, throughout the length of the heat chamber, and the cap member at the upper remote end of the tool provides single pressure release valve mechanism, for releasing excessive pressure, generated by the chemical reaction, from the heat chamber from time to time.

The invention also includes the capsules being formed of water soluble gelatin and the capsules being filled with granulated caustic soda and aluminum alloy, and the liquid in the chamber being water.

The gelatin, forming the capsules, and which enclose the chemicals, provides a temporary, water dissoluble, barrier between the chemicals and water in the heat chamber, and delays the chemical reaction for several minutes by preventing the water from immediately contacting the chemicals, and producing the heat reaction, immediately after the water and chemicals have been added or loaded into the chamber. This delay enables the tool to be loaded, capped and inserted into the well, before the water can contact the chemical long enough for the reactor to reach such a high heat intensity that the tool cannot be handled by the crew's hands without insulating cover or the like.

Furthermore, since the gelatin capsules extend the entire length of the heat chamber, the water will simultaneously contact the gelatin through the length of the cham-

ber, so that after the time to dissolve the gelatin has elapsed, the water will thereupon simultaneously contact the chemicals and cause a high temperature heat generating reaction with the chemicals, substantially uniform throughout the entire length of the chamber.

In addition, the invention includes an improved method of charging or loading the chemically reactive paraffin remover tool, so as to reduce the danger of the handling crew coming into contact with the chemicals employed.

The improved method includes removing the detachable cap at one end of the sleeve or heat chamber of the tool, and loading the rack member, with a plurality of gelatin capsules, prefilled with the chemical, and with the gelatin capsules entirely enclosing the chemical to avoid direct contact of the chemical by the crew, and inserting the rack into the heat chamber, adding water to the sleeve or heat chamber into an annular space remaining in the chamber, and thereupon capping the end of the sleeve to completely seal the sleeve in watertight relation. The capsules, although being formed of water soluble gelatin, are of a sufficient thickness to enable the water to be added, and the chamber sealed or closed, before the water can dissolve the gelatin and directly contact the chemical to cause the chemical reaction, thereby preventing endangering the oil crew from being burned by direct contact with the chemical, on being exposed to the chemical reaction, created when the water contacts the chemical.

With further reference to the drawings, FIGURE 1 is an overall side elevation disclosure of the chemically heated tool invention 15, revealing the elongated cylindrical bullet-like configuration, and illustrating the tool as suspended in vertically operative use heat treating an oil flow pipe 16, surrounded by a casing 17, of a typical oil well in the ground 18.

The annular accumulator of paraffin or wax 19, is also illustrated and has built up and solidified within the interior passage or inner diameter of the oil flow pipe 16, partially clogging or shaking the oil passageway there-through, with the heat treatment of the tool causing the paraffin to begin to melt down and become fluid.

The chemical tool invention 15 is suspended and raised or lowered in an oil well with conventional tool suspension equipment, widely used in the oil industry. The equipment may include a conventional sinker bar 20, for weighting the tool down. The lower end of the sinker bar is provided with a threaded socket 21, for threadably receiving and attaching the upper end of the chemical tool 15. The upper end of the sinker bar is manually attached to a conventional wire line socket, which wire line socket is attached to the derrick line or wire line used for raising and lowering the tool.

The sinker bar 20, is also customarily provided with a swivel joint consisting of a ball 22 and socket 24, to enable the attached tool to rotate freely relative to the derrick line, while the tool is suspended, and thereby prevent the twisting of the wire line or derrick line.

OVERALL CHEMICAL TOOL CONSTRUCTION

The chemical tool invention 15, includes a main, elongated, hollow, cylindrical sleeve or heat chamber 25. A annular shoulder portion 26, is formed integrally with the sleeve, and extends around the upper end of the sleeve, and a cap member or valve plug element 27, threadably attached thereto.

The upper end of the cylindrical sleeve member or heat chamber, is partially cutaway to reveal the liquid 28, filling the interior of the sleeve. The liquid is contained in the sleeve by the nose cone 29 sealing the lower end of the sleeve and the cap member or valve plug element 27 sealing the upper end of the sleeve. The upper top of the rack member 30 is shown projecting slightly above the liquid level in the sleeve 27.

The detailed construction of the chemical tool invention is best illustrated in FIG. 2, wherein the main hollow

sleeve member, is cut away along its length, revealing the interior of the chemical tool.

PLASTIC RACK MEMBER

The elongated rack member or capsule holder 30, is a removable component of the chemical tool. The rack member 30 is formed of plastic, is aligned centrally along the length of the hollow sleeve, with its center axis substantially coinciding with the center axis of the sleeve. The plastic rack 30, includes a plurality of plastic ledges or spacers 37, which are relatively short and are spaced at even intervals along the length of the rack member and also are formed integrally with the longitudinally extending base portion 38 of the rack 30.

At the upper and lower end of the rack member are plastic tongues 39 and 40, respectively, which project in longitudinal opposed relation to the rack. The upper and lower tongues 39 and 40, each having an eyelet 41 and 42, formed therethrough, to facilitate handling and storing the capsule holder or rack.

The ledges or capsule spacers 37, are circular or disc-like in shape and provide a spacing means for each of the plurality of the capsules.

The cylindrical gelatin capsules 44 are positioned centrally along the sleeve, by resting within the curved concave face portion 45, of the elongated base 38 of the plastic rack member 30, with the remote ends 46 and 47 of each capsule holder abutting the face of the pair adjacent spacers or ledges 37.

Each ledge of the plastic rack member is provided with a plurality of holes 48, which allow the liquid 28, to mingle more freely with the plurality of capsules, when the liquid is added into the sleeve and thereby aid in the freer flow of liquid between the capsules.

NOSE CONE ASSEMBLY

The tapered nose cone 29 (see FIGS. 2 and 3) has a hollow cylindrical upper interior 49, and a frusto-conical lower hollow portion 50, which acts to telescopingly receive the lower end of the capsule holder 30, and the lowermost capsule mounted thereon.

The upper end of the nose cone 29 has an outer reduced neck 51, which is provided with external threads or grooves 52.

The lower end of the sleeve 25 is provided with an annular internal collar 53, fitted therein. The collar 53 has cooperating externally threaded grooves which enable the nose cone to be screwed onto the lower end of the sleeve 25 of the chemical tool.

A circular copper ring seal 54 is interposed between the ridge 55, adjacent the reduced neck of the cone, and the lower remote edge 56, of the cylindrical sleeve and acts to create an air tight seal between the nose cone and the metal sleeve of the chemical tool.

The elongated annular longitudinal spacing 57 in the metal sleeve, provides space for filling the metal tube or sleeve with liquid when the chemical tool is loaded for use. The spacing 57 extends substantially the entire length of the sleeve, from the upper end adjacent the disc portion 26, to the lower end of the sleeve, where the nose cone is attached.

Spacing 57 is provided in the hollow interior of the cone, annularly around the lowermost capsule, to enable the liquid 28 in the chemical tool to surround the exterior of the lowermost capsule. The base portion 38 of capsule holder or rack member 30, along the lower portion adjacent the nose cone, rests nearly flush with inner cylindrical face 50 of the cone, with the tongue member nesting in the frusto conical portion, and together cooperating to maintain the capsule holder in its central axial position relative to the metal sleeve.

Additional support may be provided at the upper end of the sleeve, adjacent the disc portion 26 to assist in maintaining the rack in its central axial position.

PRESSURE RELEASE VALVE MECHANISM

The pressure release valve mechanism is best illustrated in FIG. 3. In this figure, the pressure release valve is constructed internally of the cap member or plug element 27, within the central portion of the plug element.

The cap member or plug element 27, has an enlarged central cylindrical housing portion 62, of substantially the same diameter as the outside of the metal sleeve, and has opposed reduced neck or shank portions 63 and 64, each of which are threaded. The lower neck 64 and its threaded grooves are screwed into the central bore 65, of the shoulder portion 26, at the upper end of the sleeve. The upper neck portion 63 is threadably receivable in the sinker bar socket 21 of the sinker bar 20.

The pressure release valve mechanism 59 includes a helical metal spring 60, mounted in a central bore 61, which extends axially along the length of the plug element. The mechanism also includes a slidable guide plunger 66 (FIGS. 3 and 5), having a cylindrical portion 67, which projects into the lower end of the helical spring with an annular cylindrical shoulder 68, limiting the movement of the plunger into the spring. The shoulder 68 is chamfered along three sides to form flat surfaces 68'. The plunger 66 has a cylindrical lower end 69, which is also chamfered along three sides 69'. The chamfering 68' and 69', provide narrow passageways along the length of the plunger between the bore and between a socket 70 of the cylindrical screw insert 71.

The lower end of the slidable plunger rests in the socket 70, and also is provided with a spherical recess 70', to receive in close conformity the upper surface of the ball bearing 72.

The lower end of the central bore 61, along the reduced neck portion 64, of the plug element is provided with internal threads for threadably receiving the cylindrical screw insert 71. The upper end of the screw insert is also provided with a spherical recess 74, at the lower end of its socket 70, offering a nesting or seating surface for the lower portion of the ball bearing 72.

The cylindrical screw insert 71 also has a small longitudinally extending bore 71', which communicates with central bore 65, and the interior of the sleeve.

Opposed grooves 74' are provided along the lowermost edge or end of the screw insert, for inserting a screwdriver head therein and turning and threading the screw insert into the central bore 65.

At the upper end of the central housing 62 of the plug element, are a plurality of ducts or ports 75, four in number (FIGS. 3 and 6). These ports originate in openings in the central bore 61 and provide communication therewith, and diverge laterally and radially outward, at approximately 90 degrees to one another terminating in openings at the outside of the central housing, thereby providing four radial passageways from the central bore to the outside of the tool.

A pair of opposed recesses 76 and 76' in the central housing act to recess two of the ducts 75 so as to reduce the likelihood of foreign material being pressed into all the ducts, and prevent the release of pressure there-through, since if all the duct outlets were flush with the cylindrical surface of the tool, there would be a strong likelihood that the radial ducts might be clogged by foreign material in the well, rubbing against the ducts when the tool is lowered into the well.

GELATIN CAPSULES

The gelatin capsules 44, set forth in FIGS. 2, 3 and 7, comprise one of the components of the chemical tool inventions. The plurality of individual gelatin capsules, positioned along the length of the plastic rack member or capsule holder 30, are each moulded of water soluble gelatin material. Each capsule consists of two overlapping gelatin shells 46 and 47, with each gelatin shell having a cylindrical body portion with their outer ends terminating in spherical closures 80 and 81, and with open

inner ends 82 and 83. The gelatin shell 46, is filled with the chemical for producing the heat reaction, and the other gelatin shell 47, is telescoped over the open end 82 of shell 46 in overlapping relation to assemble the capsule into a sealed enclosure. The gelatin capsule 44, being formed of water soluble gelatin will, upon contact with water, gradually dissolve into solution with the water. The capsules 44 are filled with granulated chemical materials 84 (FIG. 3) which chemical materials, after the gelatin dissolving delay, will contact the water and create the chemical heat producing reaction.

CHEMICAL REACTING MATERIALS

To produce the desired chemical heat reaction, many different chemicals and fluids may be employed, however, the preferred chemical combination is caustic soda (sodium hydroxide) in combination with an aluminum alloy predominately of aluminum, with minor percentages of copper and iron, in contact with water as salt water.

The following is an example of this combination:

Example 1a

Chemical materials enclosed in gelatin capsules, by weight:

Caustic soda -----	Parts 4.4
Aluminum alloy -----	1

Ratio of chemical materials to water surrounding the gelatin capsule and filling the sleeve (by weight):

Chemical materials -----	Parts 7
Water -----	18

Another example employing the same chemical materials with a different blend, is the following:

Example 1b

Chemical materials, enclosed in gelatin capsules, by weight ratio:

Caustic soda -----	Parts 3
Aluminum alloy -----	1

The ratio of water to chemical materials, may remain constant, for the various different blends which may be employed.

The water also may be saturated in each example with a certain amount of salt, if desired.

Another example employing the same chemical materials with a further different blend, having the following ratio:

EXAMPLE 1c

Chemical materials, enclosed in gelatin capsules, by weight ratio:

Caustic soda -----	Parts 2.34
Aluminum alloy -----	1

Although it is a preferred form of the invention to employ the chemicals set forth in Examples 1a, 1b, and 1c, namely, caustic soda, or aluminum alloy, in combination with water, other suitable chemicals may be employed satisfactorily.

An example of another chemical and liquid which may be combined to produce the heat reaction is magnesium in combination with hydrochloric acid and water.

EXAMPLE 2

Chemical material filling the gelatin capsules:

Magnesium pellets -----	100%.
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Liquid filling the sleeve and reacting with the chemical, by percentage volume:

Water -----	Percent 50
Hydrochloric acid -----	50
(The hydrochloric acid is of 36% strength.)	

The temperature of the chemical reaction may be regulated by varying the blend of the chemicals. For example, if it is desired to raise the level of temperature, when using caustic soda, iron, copper and aluminum in combination with water, the temperature of the reaction can be raised by increasing the percentage of caustic soda, with respect to the aluminum, to weight ratios on the other of Example 1a.

If on the other hand it is desired to lower the temperature of the heat reaction, the percentage of caustic soda, to the aluminum alloy may be lowered to such as set forth in Example 1b or 1c.

While the blend of the chemical material may be varied to change the temperature reaction, the overall quantity of chemical materials, with respect to the water, normally remains the same. It is also desirable that the quantity of water remains constant in most cases at least to the extent that the water substantially fills the annular space, so that the water may contact the uppermost capsules, when the tool is raised to a vertical position for insertion into the well.

ALLOY CAPSULES

A modified chemical capsule 90, is disclosed in FIG. 8, which capsule comprises overlapping shells 91 and 92 made of the aluminum alloy rather than gelatin. The alloy shells 91 and 92, forming a capsule, are provided with a plurality of very small perforations or apertures 93. The caustic soda is packed tightly within the perforated aluminum capsule and the plurality of small perforations made in the capsule allows water, filling the sleeve, to enter into the capsule and contact the caustic soda. The contact of the water will cause the chemical reaction to take place in the perforated areas and will gradually enlarge the size of the perforations as the chemical reaction takes place. The alloy capsule may also be coated with a layer of gelatin to provide the gelatin delay action.

BIRD CAGE RACK MEMBER

A modified rack member such as the stainless steel bird cage rack member 84, in FIG. 9, may be employed in lieu of the plastic rack member 30. The stainless steel rack 84, has the same length and diameter as the plastic rack, and comprises a plurality of stainless steel rod supports 85, 86, and 87, with a plurality of perforated stainless steel discs or ledges 88, mounted at spaced intervals along the length of the rod supports. The discs or ledges 88, provide ledges for the capsules in the same manner as the plastic ledges of the plastic rack member 30. The capsules are mounted in the rack by being pressed fitted laterally into the rack between each ledge, with only two rod supports being spaced sufficiently far apart to enable the capsules to be passed between and mounted. The upper end of the rack member 84, may be provided with a loop for handling the rack.

The bird cage rack may be detachably mounted into the tool in the same manner as the plastic rack member, and the bird cage structure when disposed within the heat chamber, will act to confine the chemical core or capsule in a central positioning along the length of the heat chamber. The lowermost end of the bird cage rack telescopes centrally into the nose cone in the same manner as the plastic rack member.

PRE-ASSEMBLY OF THE CHEMICAL TOOL

Prior to actually using the tool in the oil fields, for paraffin removal, it is desirable that the tool be at least partially assembled, so that it may be rapidly charged and finally assembled by the crew, when the tool is needed by the oil crew, without any unnecessary delay or waste of time.

The pre-assembly consists of, first, installing the pressure release valve in the plug element 27, by inserting the helical spring 60, into the central bore 61, thereafter inserting the plunger 66, into the bore 61, with the cylindrical end 67, placed into the center of the spring 60, until

its annular shoulder by abuts the spring. Thereafter, inserting the ball 72 into the bore against the recess 70' at the lower end of the plunger 66. The screw insert 71 is then threaded into the bore 61 until its upper spherical recess 74 engages the underside of the ball 72 and pressing the ball and the plunger 66 upward thereby compressing the helical spring.

When the screw insert is completely threaded into place, as illustrated in FIG. 3, the spring is under compression, forcing the plunger downward, which in turn forces the ball 72, into and against the small bore opening 71' and tightly into the recess 74, closing the bore 71' to prevent fluid from passing through.

The threading of the screw inserted into place completes the installation of the pressure release mechanism into the plug element 27. Normally, the pressure release valve mechanism is never thereafter disassembled from the plug element, except for cleaning or repair.

The nose cone is then attached to the sleeve, by threading its reduced neck 51 into the annular collar 53 of the sleeve, the annular collar having been pre-fitted into position in the sleeve.

The nose cone having been attached, the rack member may be stored, empty of its chemical capsules, in the sleeve, of the tool, by inserting it through the central bore 65 at the upper end of the sleeve, before attachment of the plug element or cap member 27. The tool may now be placed in a storeroom at the oil field until its time of use.

The gelatin capsules 44 are pre-filled with the desired chemical blend, by qualified personnel and being relatively small in size, for example, 2" long, $\frac{3}{4}$ " in diameter and a shell thickness of approximately $\frac{1}{32}$ ", they may be conveniently stored at the oil field site for use by the oil crew. Also a variety of different blends may be provided for use.

LOADING THE TOOL WITH ITS CHEMICAL CHARGE AND OPERATING THE TOOL FOR PARAFFIN REMOVAL

When at a producing oil well, difficulty is experienced in attaining the proper flow of oil through the oil well tubing extending down to the oil bed or oil location, because of paraffin accumulation in the tubing, the oil crew will take the chemical tool and lay it horizontally on the ground, and unthread the plug element, or upper cap member 27, from the central bore 65, of the tool.

The tool is to be operated by being suspended from a derrick line and raised and lowered by the same, the detached plug element 27, with the pressure release mechanism installed, is then attached to the derrick line by threading the upper reduced neck portion 63 of the plug element, into the socket of a conventional wire line socket, which wire line socket is in turn attached to the derrick line or wire line.

If additional weight is necessary to sink the tool down into the tubing against the force of oil and gas pressure in the oil well, a conventional sinker bar 20 is threaded into the wire line socket, and the chemical tool is attached, instead, to the lower end of the sinker bar 20 by threading the reduced neck 63, into the socket 21 at the lower end of the sinker bar, in the manner illustrated in FIG. 1.

For purposes of illustration, the loading and operating of the tool, will be described with the use of the gelatin capsules pre-filled with a granulated chemical mixture of caustic soda, and aluminum alloy in the ratio indicated in Example 1a, and also employing the removable plastic rack member 30.

The plug element 27, having been detached from the tool, and mounted to the derrick line, one of the crew may reach into the opening of the central bore 65, at the end of the sleeve and grasp the plastic rack member 30, and withdraw the same from the sleeve through the bore 65.

Laying the plastic rack member or capsule holder 30, horizontally, with the spacer members 37, extending upright, the gelatin capsules are loaded onto the rack by

being pressed between each spacer member 37, and flush with the base 38, of the rack, in the manner illustrated in FIGS. 2 and 3.

Because of the press fit, the capsules will be retained in this position under substantial friction, so that the rack may be raised vertically without the capsules readily falling out.

The rack member 30, loaded with gelatin capsule, containing the caustic soda mixture, is then lifted and inserted into the open central bore 65, of the sleeve, until the rack member rests completely within the sleeve with the remote end of the rack telescopically projecting into the nose cone, in the manner illustrated in FIGS. 2 and 3.

The end of the sleeve, where the central bore 65 is located, is then pivoted upward, and water is added or fed into the sleeve until the remaining space is nearly entirely filled with water.

After the water has been added, the plug element or cap member 27, is remounted to the tool, by screwing its lower reduced neck portion 64, into the central bore 65, with the annular ring seal placed between to provide a watertight seal between the sleeve and the plug element 27, along their circumferentially adjacent surfaces.

The nose cone 29, having been attached to the sleeve, during the pre-assembly, the heat chamber or sleeve 25, is now completely sealed, chemically charged, and ready to be used for the heat treatment upon the paraffin.

The tool may now be lowered into the well, in cooperation with conventional "oil saver" equipment. Most producing wells are or can be equipped with what is defined in the oil industry as an "oil saver," which is a vertical chamber device at the top of the well, and it is through oil saver devices that various tools such as the chemical tool invention can be raised or lowered into the well with a derrick line, while keeping the well from blowing out.

GELATIN DELAY ACTION (GELATIN CAPSULES)

The water, when fed into the sleeve of the tool, can not immediately react with the chemicals because of the gelatin capsules which enclose the chemicals and prevent the water from contacting chemicals. Consequently, there is a delay in the chemical heat reaction until the water has had time to dissolve the capsules, so that it may come into contact with the chemicals and react.

Since the chemical reaction for the caustic soda mixture and water is characterized by producing practically instantaneous heat upon the contact of the water with the mixture, thus dissolving action delay, is of importance, since it is desirable to hold up the chemical heat reaction so that the plug element can be attached to the tool inserted into the well, before the tool can become too hot from the intense heat generated by the chemical reaction. Otherwise, asbestos gloves or other like insulation may be needed for the hands of the oil crew, attaching the cone and inserting the tool, to prevent their being burned.

However, this gelatin dissolving action generally takes several minutes, and this will normally be more than adequate time to attach plug element and lower the chemical tool into the well before it becomes too hot to handle without the previously mentioned insulation.

Furthermore, this dissolving delay action, when adding the water into the sleeve of the tool, prevents the oil crew from being exposed to the effects of an instantaneous chemical reaction.

Also since the caustic soda mixture is completely encased in the gelatin capsules, there is little danger of the oil crew, while loading the rack with the capsules, of the chemicals accidentally contacting the bare hands of the operator, where it might react if a substantial amount of water or moisture were present on his hands, and produce burns.

In addition, the feature of the chemicals being encased in the water soluble gelatin capsule, facilitated a simplified construction of the tool, as only a single chamber need be provided in the tool and valve structure is not

needed, to release the liquid so that it may contact the chemicals.

The thickness of the gelatin capsules may be varied, as well as their composition, in order to lengthen or shorten the time necessary to dissolve capsules, and thereby regulate the time delay before the chemical reaction can begin.

The chemical reaction of the water and the caustic soda mixture in the capsules (Example 1a) will generate heat of a rather high intensity, on the order of 300° F., for approximately thirty minutes to an hour. The degree of heat generated will rise rapidly to this 300° F., soon after the water contacts the chemicals, so that within a few minutes after the tool has been inserted into the well, heat will be radiating from the tool at its maximum temperature or level.

As the tool is gradually lowered down the oil well tubing, it will melt its way through any paraffin accumulations it may encounter, which have built up along the sides of the oil well tubing. Furthermore, since the sleeve is relatively close to the sides of the tubing it will also melt down any lingering ridges of paraffin, under normal conditions.

Also since the heat chamber of the chemical tool comprises substantially the entire length of the tool, and since the chemical is disposed along the entire length of the chamber, the paraffin will be continuously subjected to the heat throughout nearly the entire length of the tool, as it passes by.

The nose cone, will be generating a slightly higher degree of heat than the sleeve, because of the lowermost capsule and chemical reaction being in closer proximity to the cone, which will facilitate the initial melting of the tool through the paraffin.

If, after using the tool in the oil well tubing, for the thirty minutes to an hour, the paraffin has not been removed to their entire satisfaction, the tool may be raised to the surface again and recharged.

The chemical heat reaction taking place in the tool, will generate gas and steam pressure in the heat chamber or sleeve.

In order to reduce the likelihood of the pressure built up from spraying the oil crew with the chemical composition, when the plug element is removed for recharging, the pressure release valve mechanism is provided. The release valve mechanism enables the pressure generated within the sleeve to be released from the heat chamber, during the course of the chemical reaction and before the nose cone is removed by the crew for recharging, and also prevents foreign material from entering into the chamber.

The pressure relief valve mechanism automatically opens when an excessive amount of pressure has built up in the sleeve, since the excessive pressure may overcome the spring biased ball bearing, and force the plunger upward, thereby opening the passage in the small base 71', and enabling the excessive pressure to expand and escape upward through the base along the spaces, provided by the chamfered surfaces 69, on the plunger, and on up through the central bore 61, to the top thereof, where there is deflected out through the radial ports 75, to the outside of the tool.

When the pressure within the chamber drops below the force necessary to overcome the spring, the ball will then be forced down into the spherical recess, thereby closing the passage in the bore 71', and again sealing the heating chamber.

The compressive force of the spring may be regulated by turning or screwing the threaded insert 71 upward or downward, so that the valve will open at the desired pressure level.

Since the pressure relief valve has released the excessive pressure within the chemical tool, during the chemical reaction, the recharging operation can be safely accomplished.

For recharging the tool, the plug element will be removed again, and the water and chemical materials in their exhausted form, may be flushed or poured out. The rack member can be then removed, loaded, and reinserted into the sleeve, and the sleeve again filled with water, and the plug element re-attached. The chemical tool may be lowered again into the well tubing for another heat treatment to further remove the paraffin.

The oil well tubing may be flushed or pumped out between or during each heat treatment, so as to remove the melted paraffin.

Although, the operation of the chemical tool was described with the use of the chemicals and liquid set forth in Example 1, specifically 1a, namely, caustic soda, copper, aluminum, and iron to react with water, the chemical tool invention can be effectively operated by employing the chemicals and fluids of Example 2, namely, magnesium to fill the capsule, and a fluid mixture of hydrochloric acid and water. The water and hydrochloric acid solution will also dissolve the gelatin capsules and enable this solution to contact the magnesium, upon contact with the magnesium, a high degree of heat will also be generated, of somewhat comparable intensity with the caustic soda and other materials in Example 1.

While any suitable chemical may be employed which when contacted by a liquid, will generate a substantial amount of heat, because of the safety factor, it is preferable to use any chemical which will react with water as a fluid, or some other fluids harmless to the human body, since when such fluids as hydrochloric acid are employed, in concentrated amounts, there is the ever present possibility of the acid mixture accidentally spilling onto the flesh of the crew man operating the chemical tool, and causing severe burns.

The locating of liquid in the annular space 57 between the sleeve and the chemical produces an acceleration of the heat transfer to the sleeve of the tool by virtue of convection currents set up in the liquid, as a result of the rather violent turbulent chemical reaction created, when the water contacts the generally located chemicals.

This chemical reaction in producing a rather violent turbulent agitation on circulation in the water as a result of the intense heat being produced and the gas and steam pressure being generated, causes the heat, by convection, to move outwardly with extreme rapidness to the sleeve, and as a result the heat may reach the sleeve while still at or near the peak intensity, or before its temperature can drop too appreciably. Accordingly, this results in a hotter sleeve temperature.

Since the sleeve will receive heat at a higher temperature by virtue of the convection effect, accordingly higher intensity or degree of heat will be radiating against the adjacent paraffin accumulations on the walls of the tubing, and thereby producing a faster melting of the paraffin.

Nearly all of the chemical tool, generates heat, since the heat chamber extends nearly the entire length of the tool, and the plurality of capsules are located along nearly the entire length of the heat chamber or sleeve, with the fluid for creating the reaction laterally adjacent the chemical throughout nearly the full length of the sleeve. Furthermore, the fluid can simultaneously contact and dissolve all the capsules along the sleeve, so that the heat generated will be evenly and uniformly produced throughout the length of the tool; thus substantially eliminating the creation of a hot spot at only one area in the tube, which has been known to take place when the fluid can only contact the chemical at, for example, one end of the chamber. Also the central location of the chemicals enables a relatively uniform radial distribution of the heat.

The spacer member of the rack member capsule holder 30 also facilitates the prevention of a localized hot spot, as the spacers act to prevent the chemicals from gravitating or settling to the bottom of the tool. Also the plural-

ity of apertures or holes in each spacer member enables a free circulation and co-mingling of the chemical and fluid, during the chemical reaction for more uniform heating.

HEATING ACTION OF ALLOY CAPSULE

When employing the aluminum alloy capsules 90, in the operation of the tool, the caustic soda is packed tightly within the capsule and the perforations, in the capsule, are relatively small, so that a heat delay action also occurs within the alloy capsule. When the water first enters the perforations, the chemical reaction will be somewhat nominal, until the size of the perforations gradually enlarge and thereby expose more caustic soda to the water, so that the chemical reaction can accelerate. Since the water when added to the sleeve will not cause an intensive heat reaction, immediately, the tool may be safely capped and inserted into the well, before the heat reaction reaches high temperatures.

Also since the chemical reaction begins in the perforated areas, the general dimension and shape of the capsule, will not be altered or diminished for a substantial period of time, which facilitates the adaptability of the alloy capsule to various types of rack members, in maintaining the relative position of the chemical capsule in the sleeve.

The alloy capsule, when coated with gelatin, will be further delayed in its best reaction acceleration, as the gelatin must dissolve out of the perforations before the chemical reaction can take place.

Also various other chemically reactive materials may be formed into capsule dimensions, in addition to those specifically mentioned.

By virtue of its simplified construction, and the chemicals being in a capsule form, as well as the employment of a single removable plastic moulded rack member moulded in a single piece, the invention can be inexpensively produced, as well as be rapidly assembled and operated for the heat treatment of the oil wells.

It may be readily seen, however, that the invention provides a number of other features, in addition to those specifically described.

The metal sleeve of the chemical tool forming the chemical heat chamber, is made of stainless steel material. In addition all other components of the tool, such as the rack or capsule holder, and nose cone, which are in contact with the chemical or the chemical and fluid during the course of their chemical reaction, are made or treated in a manner to be a non-corrosive.

It is intended that various different sizes of chemical tools, will be provided, so that the outside diameter or circumference of the tool may be relatively near or closely adjacent to inner diameter of the oil tubing, for a more effective hearing application upon the tubing. The actual or physical dimensions of the tool will differ in accordance with the particular size tubing used, in accordance with the American Petroleum Institute requirements and specifications.

For example, in an oil tube or pipe having a two inch inner diameter, the outside diameter of the chemical tool will be an inch and one half. Furthermore in a chemical tool having an inch and one half outer diameter, the length of the tool may be approximately 3 feet, 3 inches and will contain 15 capsules.

Although the present invention has been described or operated by being suspended from a wire line and weighted by a sinker bar to submerge the tool downward into the well, the invention may be utilized or employed for the removal of paraffin, in shut-in wells, where the chemical tool is simply dropped into the well and allowed to gradually sink to the bottom, under its own weight, and then brought to the surface by oil and gas pressure when the well is again opened up.

It is also possible, when using an "oil saver" device to allow the tool to drop to whatever depth the operator

desires and the descent of the tool may be stopped by simply opening up the well to allow the oil flow and oil flow pressures to bring the tool to the surface, into the oil saver chamber, where the tool is again captured.

In the crude production, the problem of paraffin accumulation is also encountered in the various horizontal flow lines and gathering lines, i.e., running from the well head to crude tank batteries. By reducing the length of the tool, the chemical tool invention can be used to remove paraffin from such horizontal lines, flow lines and gathering lines. This is accomplished through the use of pressure by introducing the tool into the tube or pipe and allowing the pressure to move the tool through the pipe to a joint.

The pressure is then turned off and the joint opened and the tool removed, the well pressure being the driving force.

While the present invention has been described in connection with the removal of paraffin in the bore hole tubing of an oil well, and in horizontal oil flow lines, the invention may be utilized or employed for various other purposes of a similar character.

Furthermore, it will be obvious to those skilled in the art, that various changes may be made in the invention, without departing from the generic spirit and scope thereof, and, therefore, the invention is not limited by that which is shown in the drawings and described in the specification, but only as indicated in the appended claims.

What is claimed is:

1. An elongated heat producing tool for removing paraffin from oil wells, said tool comprising an elongated hollow sleeve closed at both ends, a plurality of capsules, said capsules being formed of dissolvable material, said capsules each containing a chemical, an elongated rack, said capsules being mounted in said rack at intervals along the length of said sleeve, fluid in said chamber, said fluid being adapted to react with said capsules to produce an exothermic heat reaction, said sleeve having a pressure release valve means for releasing excess pressure produced by said heat reaction.

2. A chemical tool for removing paraffin from oil passages, said tool comprising an elongated heat chamber, a plurality of chemical capsules, said capsules being formed of dissolvable material, said capsules each containing a chemical, an elongated rack member for loading and positioning said chemical capsules in a row within and longitudinally along the length of said chamber, fluid in said chamber, said fluid and said chemical capsules reacting together to produce an exothermic heat reaction, said rack member having open areas along its length to allow said fluid to contact each of said capsules, said chamber having a pressure release valve means for releasing the excess pressure generated by said heat reaction.

3. A chemical tool for removing paraffin from oil wells, said tool comprising an elongated heat chamber, a plurality of chemical capsules positioned within and in a row longitudinally along the length of said chamber, said capsules being formed of dissolvable material, said capsules each containing a chemical, fluid in said chamber adapted to dissolve said capsules and react with said chemicals to produce an exothermic heat reaction; an elongated rack member extending along the length of said chamber and receiving said capsules and aligning said capsules in such chamber, said chamber having a pressure release valve mechanism for releasing excess pressure generated by said heat reaction.

4. A chemically heated tool for oil well tubing comprising an elongated chamber closed at both ends, a plurality of chemical capsules positioned in said chamber in a row along the length of said chamber, said capsules being formed of dissolvable material, said capsules each containing a chemical, elongated rack means for loading said chemical capsules into said position in said chamber,

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fluid in said chamber disposed circumferentially about said chemical capsules, said fluid being adapted to react with said chemical capsules to produce an exothermic heat reaction, spaced ledge means in said rack means at intervals along the length of said rack means and between said chemical capsules for supporting said chemical capsules, pressure release valve means for said chamber to release excess pressure produced by said heat reaction.

5. A chemical heating tool for melting paraffin from oil passages, said tool comprising an elongated tube closed at both ends with a detachable cap at one end, an elongated rack member in said tube, a plurality of capsules in said rack, fluid in said tube surrounding said capsules and rack, said capsules containing a filler, said capsules and filler comprising substances which react exothermically with one another upon contact with said fluid, each of said capsules having perforations to allow said fluid to contact said filler, said rack member having open areas along its length to contact said capsules, said rack member acting to align said capsules in a row along the length of said tube.

6. A chemically heated tool for melting paraffin from oil passages, said tool comprising an elongated heat chamber, chemical capsules within said chamber and positioned in a row along the length of said chamber, an elongated rack member in said chamber receiving and positioning said capsules in said position in said heat chamber, fluid in said heat chamber disposed about said capsules and said rack member, said capsules being formed of fluid dissolvable material so as to dissolve after an interval of time and allow said fluid to contact said chemicals and produce an exothermic heat reaction, said elongated rack member having an open area along its length to allow said fluid to contact each of said capsules, spaced ledge means in such rack means at intervals along said rack means and between said capsules to support said capsules and assist in such aligning of said capsules.

7. A chemically heated tool for melting paraffin from oil passages, said tool comprising an elongated tube, an elongated rack member within said tube and extending along the length of said tube, elongated capsule means within said chamber, said capsule means being formed of dissolvable material, said capsule means each containing a chemical, said rack member receiving said capsule means to load the capsule means into said chamber and acting to align said capsule means in said chamber, fluid in said chamber disposed circumferentially about said capsule means and said rack member, said rack means having open areas along its length to allow said fluid to contact said capsule means along its length, said fluid in said chamber acting to dissolve said capsule means after an interval of time to allow said fluid to contact said chemical to produce an exothermic heat reaction.

8. A chemical tool for removing paraffin from oil wells, said tool comprising an elongated heat chamber, a plurality of chemical capsules positioned within and longitudinally along the length of said heat chamber, liquid in said heat chamber, said capsules being formed of liquid soluble gelatin, said capsules each containing chemicals, said liquid in said chamber acting to dissolve said gelatin capsules after an interval of time and contact said chemicals

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with the contacting of the chemicals producing an exothermic chemical heat reaction, pressure release means for said heat chamber for releasing any excess pressure built up within the chamber, a rack member removably mounted in said chamber for supporting and aligning said capsules in said position in said chamber and to load said chemical capsules into the chamber, said chamber having a detachable cap for inserting said rack and capsules and fluid in the chamber.

9. A chemical paraffin remover tool, for use in removing paraffin accumulations with oil well tubing, said tool comprising a sleeve, forming a heat chamber, threaded plug member closing the upper end of the sleeve, a rack member extending substantially the length of the sleeve and located within the interior thereof, spacing means on the rack at even intervals along the length of the rack, water soluble capsules mounted between said spacing means, a chemical mixture of principally caustic soda and aluminum, filling each of said water soluble capsules, a quantity of water substantially filling said sleeve, a closure at the lower end of said sleeve, said plug member having a pressure release valve member communicating with the hollow interior of the sleeve and acting to release any excess pressure built up within the sleeve, the water filling the tube providing means to dissolve the water soluble capsules and thereafter react with said caustic soda mixture to generate an exothermic heat reaction within the sleeve, with the heat radiating through the walls of the sleeve, whereby the tool may be lowered into the well tubing and will melt any paraffin in the tubing blocking the passage of the tool and any lingering ridges of paraffin along the walls of the tube.

10. A paraffin remover tool for oil wells comprising an elongated tube closed at both ends, a plurality of capsules, said capsules each comprising a pair of sleeves each closed at their one end and open at their other end with their open ends overlapping, each of said capsules containing a chemical, said capsules being disposed centrally of the longitudinal axis of the tube, a fluid in said tube disposed circumferentially about said chemical, and rack means within said tube to position said capsules in end to end relation along the length of the tube, said capsules being dissolvable by said fluid so that said chemical may contact said fluid, said chemical and fluid being of a character to produce an exothermic heat reaction when in contact with the one another, valve means to release excess pressure from said tube produced by said heat reaction.

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