Feb. 16, 1932. W. L. CHURCH ET AL 1,845,238

PACKER AND SETTING TOOL

Filed Oct. 27, 1928 2 Sheets-Sheet 1

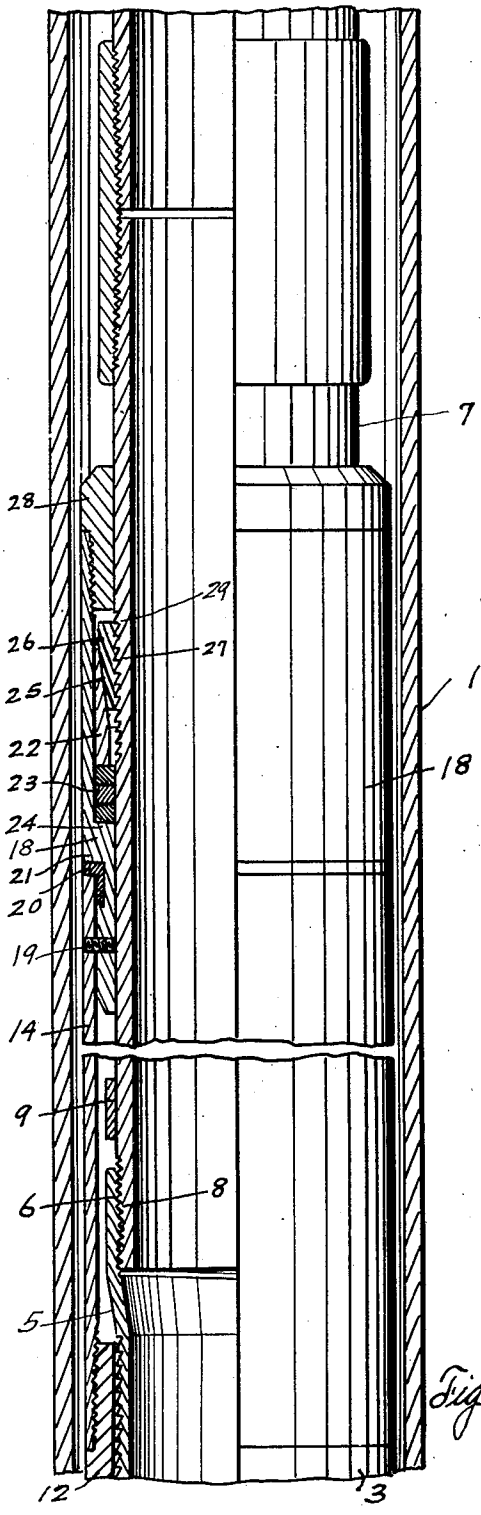


Fig. 1.

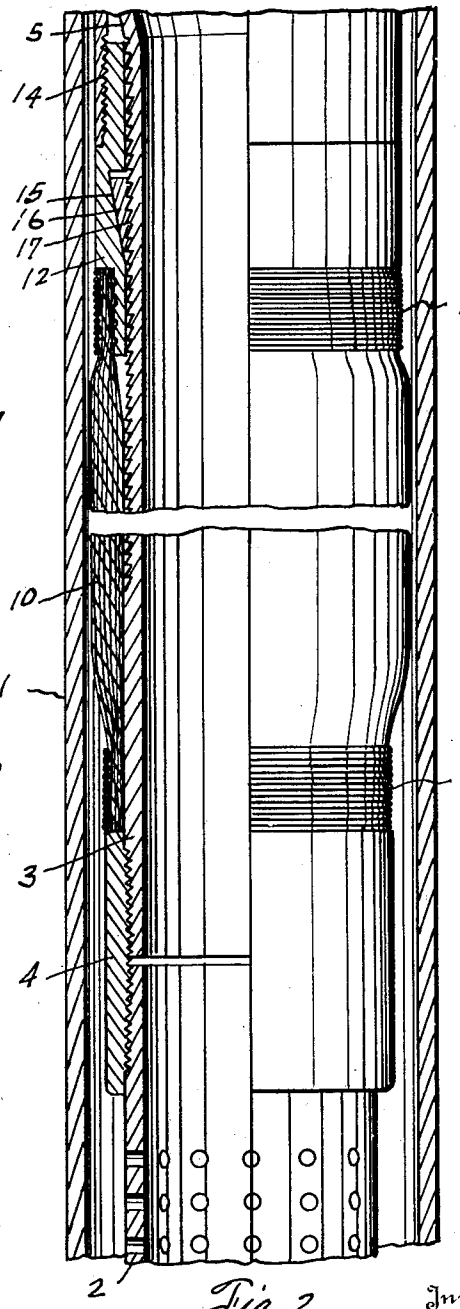


Fig. 2.

Inventors:
Walter L. Church
Brady Dixon

By Hardaway & Cathey
Attorneys

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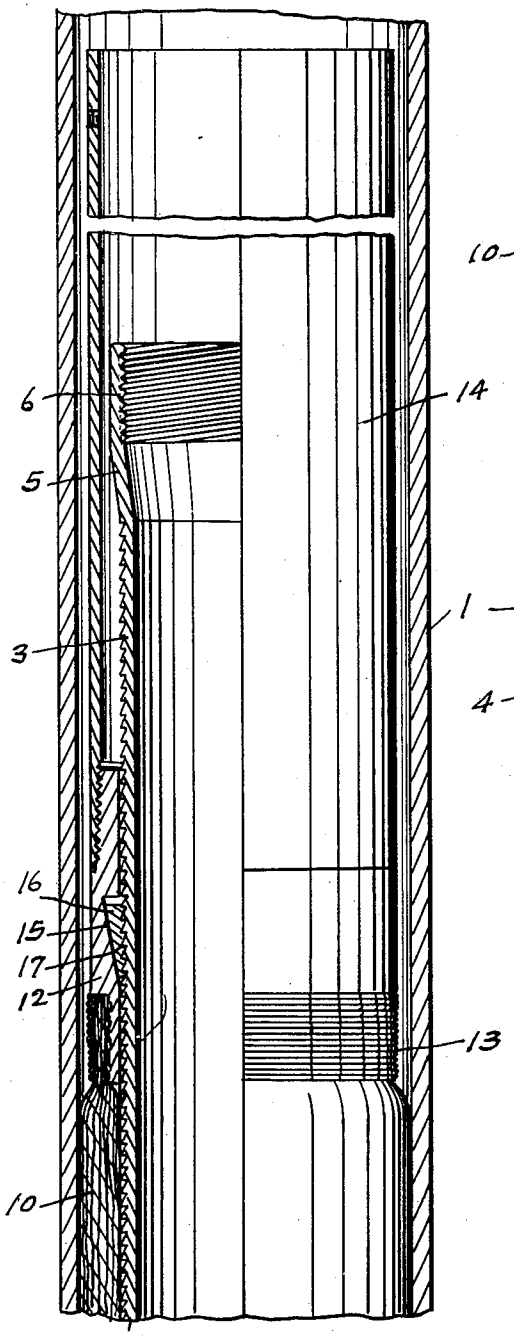


Fig. 3.

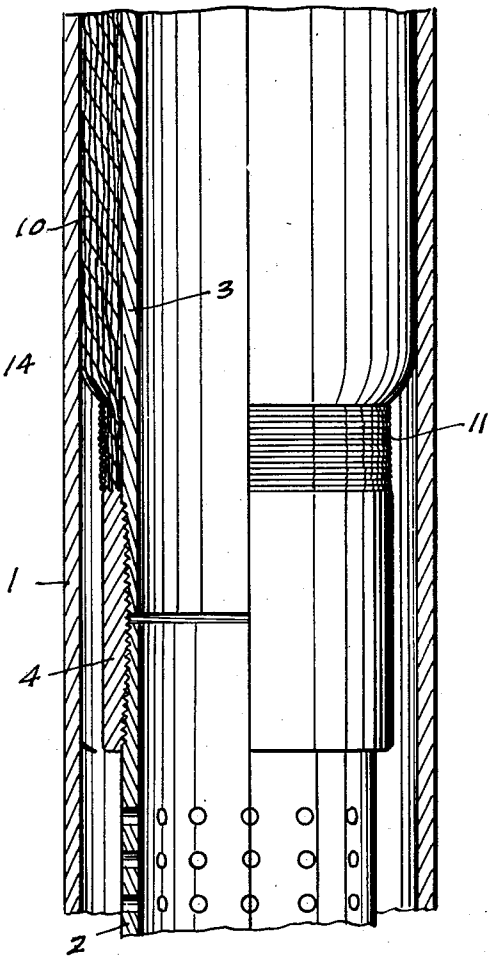


Fig. 4

Inventors
Walter L. Church
Jeddy D. Nixon

By Hardaway & Cathey
Attorneys

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UNITED STATES PATENT OFFICE

WALTER L. CHURCH AND JEDDY D. NIXON, OF HOUSTON, TEXAS

PACKER AND SETTING TOOL

Application filed October 27, 1928. Serial No. 315,362.

This invention relates to new and useful improvements in a packer and setting tool.

One object of the invention is to provide an apparatus of the character described embodying a packer adapted to form a seal between an inner pipe, such as a well screen, and an outer pipe, or other wall of a well bore, and also including a setting tool embodying a string of pipe extending to the ground surface, which string may be employed in setting the packer, when it is desired to set the same, and then detached and withdrawn leaving the packer set in the well.

Another object of the invention is to provide a packer and setting tool having a uniform inside diameter, not smaller than the inside diameter of the screen, or other inside pipe, so that in case it is desired to deepen the hole or for any reason to work through the screen there will be ample room for the working tools.

A further feature of the invention resides in the provision of novel means whereby the string may be quickly and easily released from the packer and setting tool.

With the above and other objects in view this invention has particular relation to certain novel features of construction, operation and arrangement of parts an example of which is given in this specification and illustrated in the accompanying drawings, wherein:—

Figures 1 and 2 show vertical sectional views showing the upper and lower ends, respectively of the apparatus, showing the packer in collapsed position, and

Figures 3 and 4 show vertical sectional views, respectively of the upper and lower ends of the packer with the setting tool and string detached and removed and the packet set.

Referring now more particularly to the drawings, wherein like numerals of reference designate similar parts in each of the figures the numeral 1 designates the casing forming the walls of a well bore. The numeral 2 designates a screen, or other inside pipe, set in the well bore. There is a tubular packer support 3 connected to the upper end of the screen by means of the coupling 4, and the upper end of this packer support is flared as at 5 and provided with a plurality of internal left hand threads as 6. A plurality of threads 6 preferably three or four in number are provided instead of a single thread so that said threads will have a greater pitch than will be the case if a single thread were provided. The numeral 7 designates a string of pipe adapted to extend to the ground surface and whose lower end is externally threaded with left hand threads as 8 corresponding in number and pitch to the threads 6 so that said string may be quickly connected in the upper end of the packer support 3 and securely held therein and quickly and easily detached therefrom.

Spaced above the threads 8 there is an annular external rib 9 welded or otherwise secured upon the string 7.

There is an expansible packing element 10 around the support 3, whose lower end, abuts the collar 4 and is securely fastened to the packer support as with wire 11 or by other suitable means. The upper end of the packing element 10 surrounds the lower end of the coupling 12 and is secured thereto by any suitable means, such as wire 13, wrapped thereabout. The coupling 12 surrounds the packer support and a setting nipple 14 is screwed on the upper end of the coupling 12 and surrounds and extends above the packer support.

The inner side of the coupling 12 has a downwardly converging seat 15 whereon there is seated one or more downwardly tapering wedge shaped slips 16. The contacting faces of said slips and the external surface of said packer support have oppositely pitched ratchet teeth as 17 adapted to permit the coupling 12 to move downwardly to expand the packing element and to prevent the upward movement of the coupling 12 so as to hold said packing element expanded out against the casing as is shown in Figures 3 and 4, when said element is once expanded.

The inside diameter of the string 7 is the same as the inside diameter of the screen 2 and packer support 3. It is the purpose of providing this uniform inside diameter that the packer support is flared at its upper end

so that the apparatus will not be restricted in case it is desired to work through it with tools for drilling deeper or for carrying on other work at the bottom of the bore.

There is a connecting tubular nipple 18 whose lower end is fitted into the upper end of the setting nipple 14 and secured therein by a pin or screw 19 formed of soft metal that may be easily sheared and an annular packing member 20 is located between the upper end of the setting nipple 14 and the external annular shoulder 21 carried by the connecting nipple 18.

Within said nipple 18 there is an annular sleeve 22 whose lower end is seated on the packing 23 which, in turn rests on the inside annular shoulder 24 in the connecting nipple 18. The upper end of the sleeve 22 is outwardly flared forming an inside downwardly tapering seat 25 on which the downwardly tapering wedge shaped slip or slips 26 is located and whose inner side is provided with the teeth 27. An annular gland 28 closely surrounds the lower section of the string 7 and is screwed into the upper end of the connecting nipple 18.

In bringing in a well, particularly an oil well, it is common practice to connect a full string of pipe to the upper end of the screen, said string continuing up to the ground surface. This string usually includes a packer which is attached to the upper end of the screen pipe and into which the lower end of the string proper is connected. The packer is provided so as to be in readiness for future use in case it becomes necessary to set the same. When the well comes in, that is when it starts flowing the oil flows into the screen from the surrounding strata and flows up through the string to the ground surface. When the well ceases to flow, or when it becomes necessary to install a pump to increase the flow, or when for any reason it becomes desirable to remove the string, the string is unscrewed from the packer and removed, if it can be done, and a packer setting tool is lowered into the bore and the packer is expanded, or set, thereby, when conditions are normal and such that this can be done. It often happens, however, that while the well is flowing and before the string is removed, and the packer set, that the internal pressure in the oil sand will cause the sand to "heave" that is, to be forced up around the screen past the packer and around the string above the packer. This sand is usually very fine and will find its way into the packer and between the packer and string and will pack tightly and will also pack around the string above the packer and around the packer, making it impossible to break the string loose from the packer, and also making it impossible to set the packer even if the string be removed and for the reason stated the string is often lost.

When the present invention is employed a full string of pipe may be used in setting the screen and packer and the packer expanded thereby to form a tight joint between the upper end of the screen pipe and the walls of the bore to prevent the upward or downward passage of fluid between the screen pipe and the casing or other walls of the bore, as well as to prevent the passage of sand up past said packer. When the packer is set the string may then be easily withdrawn, at the proper time, as will be more particularly hereinafter explained.

In use the apparatus is assembled as shown in Figures 1 and 2 with the lower end of the string 7 screwed into the upper end of the packer support 3 and the apparatus is then let down into the bore until the lower end of the screen 2 rests on the bottom of the bore. When the well is ready to be brought in the string 7 is turned to the right from the ground surface by any suitable apparatus provided for the purpose and the lower end of said string is thus unscrewed from the upper end of the packer support 3 and the string is then elevated until the rib 9 strikes the lower end of the connecting nipple 18.

The string 7 is then lowered and the slips 26 will engage and grip the string and will be seated securely in the seat 25 forcing the sleeve 22 downwardly and compressing the packing 23 to form a tight joint. The external surface of the string 7 cooperating with the slips 26 may be provided, if desired, with ratchet teeth 29 so as to assure the engagement of the slips 26 therewith. The weight of the string will now be sustained by the setting nipple 21 and the packing element 10 will be expanded securely against the casing 1 to form a tight joint so as to prevent the upward passage of fluid or sand as well as to prevent the downward flow of fluid that may flow into the casing from above in case of leakage therein. The oil in the oil bearing strata may now flow into the screen and up through the strig 7 to the ground surface. When the well ceases to produce or in case it should become necessary to pump the well, the string 7 may be pulled upwardly shearing the pin 19 and removed from the well leaving only the packer and setting nipple in the well as shown in Figures 3 and 4.

While we have shown what we now consider to be the preferred form of the invention it is obvious that mechanical changes may be made therein and equivalents substituted for the parts shown and we reserve the right to make such changes and substitutions as may be found desirable and such as may be comprehended within the principle of the invention.

What we claim is:—

1. Apparatus of the character described including a tubular packer support whose upper end is enlarged, an expansible packing element thereon, means around the support

through which said element may be expanded, said means including a setting nipple having means engageable with the support for holding said element in expanded position, a string of pipe detachably secured to said enlarged end support, means on the string adapted to engage said nipple and formed to permit the independent upward movement of the string relative thereto but engageable with the string to prevent the independent downward movement of said string relative thereto.

2. Apparatus of the character described including a tubular packer support, an expansible packing element thereon, means through which said packing element may be expanded, said means including a setting nipple and a device engageable with the support to hold said element expanded, a tubular string detachably connected to said support, means on the string engageable around said nipple and formed to permit the independent upward movement of the string relative thereto but to prevent the independent downward movement of the string relative thereto.

3. Apparatus of the character described including a tubular packer support, an expansible packing element thereon, means through which said packing element may be expanded, said means including a setting nipple and a device engageable with the support to hold said element expanded, a tubular string detachably connected to said support, means on the string engageable with said nipple and formed to permit the independed upward movement of the string relative thereto but to prevent the independent downward movement of the string relative thereto, and a frangible element detachably connecting said nipple engaging means to the nipple.

4. Apparatus of the character described including a tubular packer support, an expansible packing element thereon, means through which said packing element may be expanded, said means including a setting nipple and a device engageable with the support to hold said element expanded, a tubular string detachably connected to said support, means on the string engageable with said nipple and formed to permit the independent upward movement of the string relative thereto but to prevent the independent downward movement of the string relative thereto, said nipple engaging means being detachably connected to the nipple and means on the string, beneath and adapted to engage, the nipple engaging means and effective to disengage said nipple engaging means from the nipple upon upward movement of said string.

5. Apparatus of the character described including a tubular packer support, an expansible packing element thereon, means through which said packing element may be expanded, said means including a setting nipple and a device engageable with the support to hold said element expanded, a tubular string detachably connected to said support, means on the string engageable with said nipple and formed to permit the independent upward movement of the string relative thereto but to limit the independent downward movement of the string relative thereto, and means forming fluid tight joints between the nipple engaging means and the nipple and string respectively.

6. Apparatus of the character described including a tubular packer support, an expansible packer thereon, a tubular string releasably connected to said support, means operatable by the string and effective to expand, or set, the packer, said packer setting means including a device surrounding, and which engages the external surface of, the string upon downward movement of the string relative to said support and which releases said string upon an upward movement of the string relative to said support.

7. Apparatus of the character described including a tubular packer support, an expansible packer thereon, a tubular string releasably connected to said support, means operatable by the string and effective to expand, or set, the packer, said packer setting means including a device which engages the string upon downward movement of the string relative to the support, and which releases the string upon upward movement of the string relative to said support, said string engaging device and string being formed with interengaging means which limit the independent upward movement of the string relative to said device.

8. Apparatus of the character described including a tubular packer support whose upper end is flared, an expansible packer thereon, a tubular string having a threaded connection with said flared end to permit the detachment of the string from said support and the elevation of the string, means operatable by the string, upon the subsequent downward movement of the string relative to said support, and effective to expand, or set, said packer, a string engaging device associated with said setting means and effective to permit the independent upward movement of the string relative to said packer setting means but to limit the independent downward movement of said string relative to said packer setting means.

9. Apparatus of the character described including a tubular packer support, whose upper end is flared, an expansible packer thereon, a tubular string having a threaded connection with said flared end said string being detachable from, and movable upwardly independent of, the support, means operatable by the string, upon downward movement of the string relative to said support,

and effective to expand, or set, said packer, a string engaging device associated with said setting means and effective to permit the independent upward movement of the string relative to said packer setting means but to limit the independent downward movement of said string relative to said packer setting means, and other means effective to limit the upward movement of said string relative to said string engaging device.

10. Apparatus of the character described including a tubular packer support, whose upper end is flared, an expansible packer thereon, a tubular string having threaded connection with said flared end said string being detachable from, and movable upwardly independent of, the support, means operatable by the spring upon downward movement of the sring relative to said support, and effective to expand, or set, said packer, a string engaging device associated with said setting means and effective to permit the independent upward movement of the string relative to said packer setting means but to limit the independent downward movement of said string relative to said packer setting means, a frangible element connecting said packer setting means and said string engaging device.

11. Apparatus of the character described including a tubular packer support, an expansible packer thereon, a tubular setting nipple above the packer, a tubular string whose lower end is detachably connected to said support, means on the string engageable with said nipple and effective to actuate the nipple to expand, or set, said packer, said means including a string engaging device formed to permit the independent movement of the string relative to the nipple when the string is detached from the said support and elevated relative thereto and to cause the simultaneous movement of the string and nipple when the string is moved downwardly relative to said support and means forming fluid tight joints between the nipple engaging means, and the nipple and string respectively.

12. Apparatus of the character described including a tubular packer support, an expansible packer thereon, a tubular setting nipple above the packer, a tubular string whose lower end is detachably connected to said support, means on the string engageable with said nipple and effective to actuate the nipple to expand, or set, said packer, said means including a string engaging device formed to permit the independent movement of the string relative to the nipple when the string is detached from the said support and elevated relative thereto and to cause the simultaneous movement of the string and nipple when the string is moved downwardly relative to said support, and other means preventing the detachment of the string from said nipple actuating means.

13. Apparatus of the character described including a tubular packer support, an expansible packer thereon, a tubular setting nipple above the packer, a tubular string whose lower end is detachably connected to said support, means on the string engageable with said nipple and effective to actuate the nipple to expand, or set, said packer, said means including a string engaging device formed to permit the independent movement of the string, relative to the nipple, when the string is detached from said support and elevated relative thereto and to cause the simultaneous movement of the string and nipple when the string is moved downwardly relative to said support and means detachably connecting said actuating means to said setting nipple.

14. Apparatus of the character described including a tubular packer support, an expansible packer thereon, a tubular setting nipple above the packer, a tubular string whose lower end is detachably connected to said support, means on the string engageable with said nipple and effective to actuate the nipple to expand, or set, said packer, said means including a string engaging device formed to permit the independent movement of the string relative to the nipple, when the string is detached from said support and elevated relative thereto and to cause the simultaneous movement of the string and nipple when the string is moved downwardly relative to said support, and packing disposed to form fluid tight joints between the said actuating means and the setting nipple and string respectively.

15. Apparatus of the character described including an inside tubing, adapted to be set in a well bore and whose upper end forms a packer support, a packing device on said support which includes an expansible packer adapted to be expanded into contact with the surrounding walls of the bore to form a fluid tight joint, a tubular string whose lower end is detachably connected to said support, means above the packing device operatable by the string to expand said packer, said means including a string engaging device formed to permit the upward movement of the string relative to the expanding means when the string is disconnected from the support and elevated and to engage said string when the disconnected string is lowered relative to said support, said string when in said connected or said disconnected relation with the support forming a flow conduit from said packing device to the ground surface and means forming a fluid tight joint between the string and said string engaging device.

16. Apparatus of the character described including an inside tubing, adapted to be set

in a well bore and whose upper end forms a packer support, packing device on said support which includes an expansible packer adapted to be expanded into contact with the surrounding walls of the bore to form a fluid tight joint, a tubular string whose lower end is detachably connected to said support, means above the packing device operatable by the string to expand said packer, said means including a string engaging device formed to permit the upward movement of the string relative to the expanding means when the string is disconnected from the support and elevated and to engage said string when the disconnected string is lowered relative to said support, said string when in said connected or said disconnected relation with the support forming a flow conduit from said packing device to the ground surface, and interconnecting means between the string and said packer expanding means through which said expanding means may be withdrawn, with the string, from the bore.

17. Apparatus of the character described, including an inside tubing, adapted to be set in a well bore and whose upper end forms a packer support, a packing device on said support which includes an expansible packer adapted to be expanded into contact with the surrounding walls of the bore to form a fluid tight joint, a tubular string whose lower end is detachably connected to said support, means above the packing device operatable by the string to expand said packer, said means including a string engaging device formed to permit the upward movement of the string relative to the expanding means when the string is disconnected from the support and elevated and to engage said string when the disconnected string is lowered relative to said support, said string when in said connected or said disconnected relation with the support forming a flow conduit from said packing device to the ground surface means forming a fluid tight joint between the string and string engaging device said packer expanding means being detachably connected to said packing device.

18. Apparatus of the character described including a tubular member adapted to be set in a well bore, a packing device at the upper end of said member which includes an expansible packer adapted to be expanded to form a seal between the tubular member and the surrounding walls of the well bore, a tubular string whose lower end is detachably secured to the tubular member, means arranged to be actuated by the string to expand the packer, said means permitting the independent upward movement of the string, when the string is detached from said tubular member, and being formed to interconnect the string and packing device upon the subsequent downward movement of the string, to effect the expansion of said packer, said packing device forming also a substantially fluid tight joint with the string, during such upward and downward movement.

In testimony whereof we have signed our names to this specification.

WALTER L. CHURCH.
JEDDY D. NIXON.