April 19, 1960 W. W. MAIN 2,933,730

DIRECTIONAL RADIO ANTENNA ATTACHMENT FOR SURVEYORS TRANSITS

Filed April 25, 1958 2 Sheets-Sheet 1

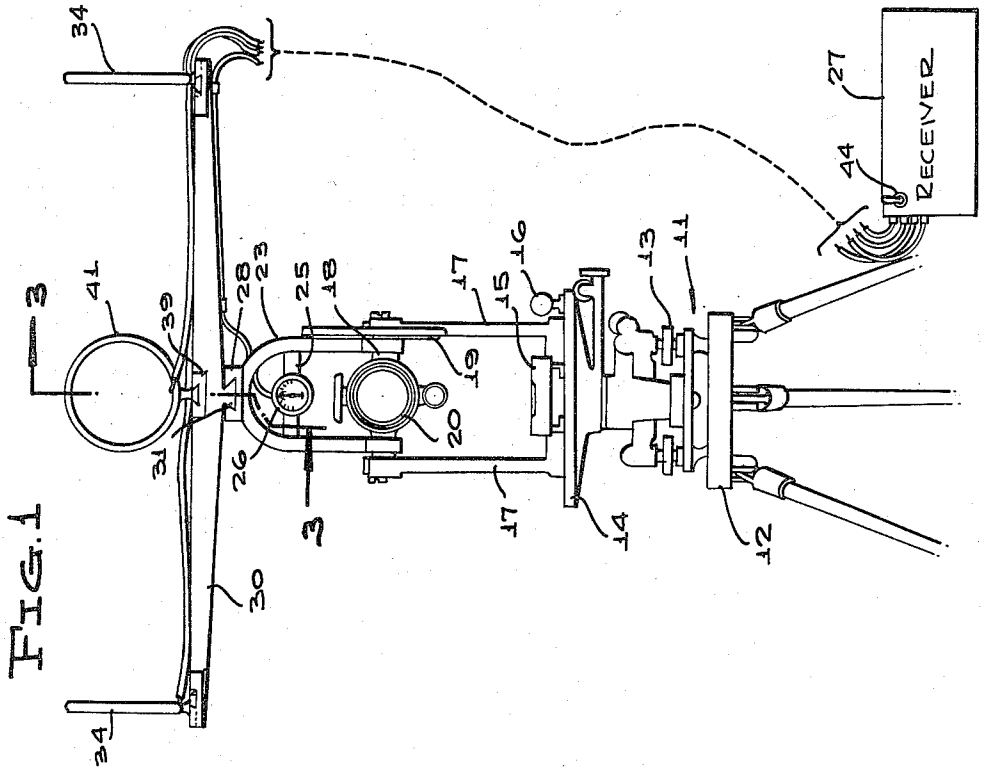


FIG. 1

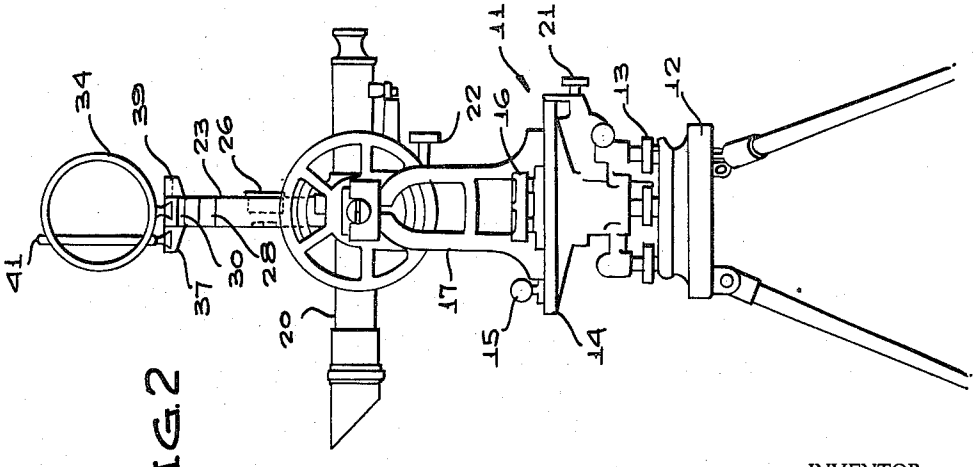


FIG 2

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FIG. 3

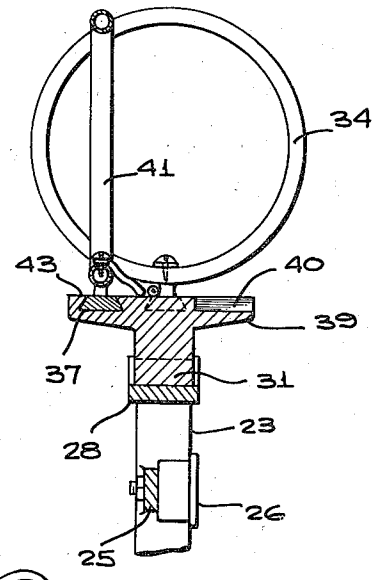
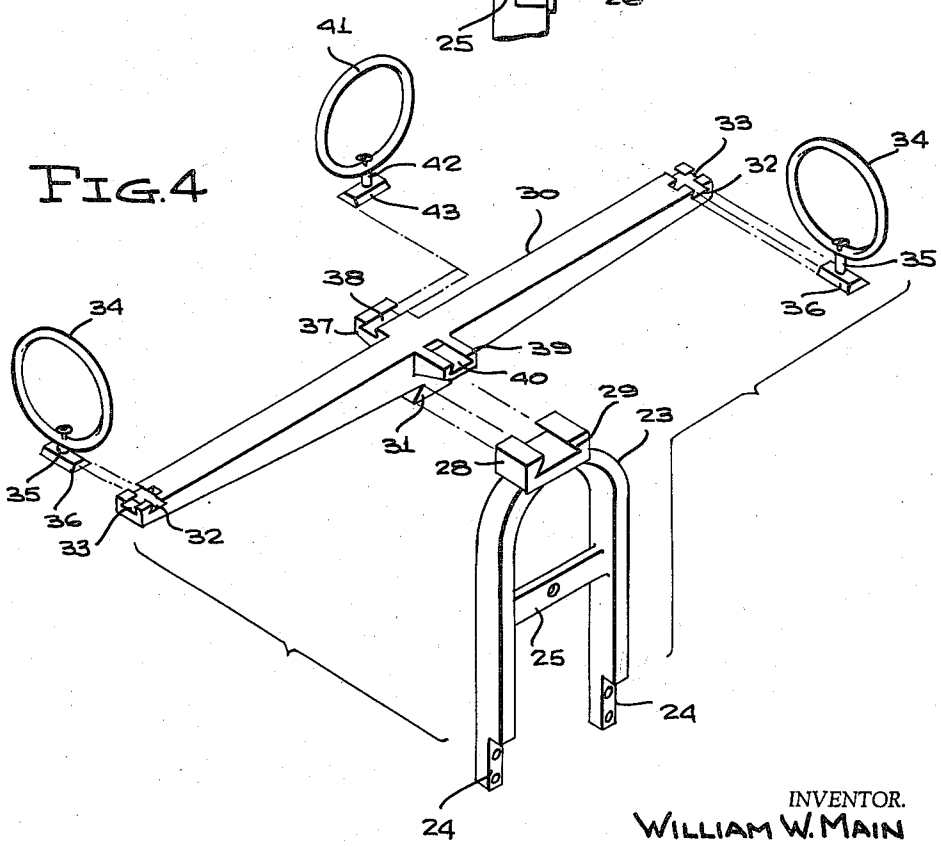


FIG. 4



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DIRECTIONAL RADIO ANTENNA ATTACHMENT FOR SURVEYORS TRANSITS

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Application April 25, 1958, Serial No. 730,889

9 Claims. (Cl. 343—720)

This invention relates to surveying instruments, and more particularly to apparatus for enabling a surveyor's transit to be converted for use with directional radio beam apparatus to enable a survey to be conducted over terrain which is unsuitable for ordinary optical surveying procedure.

A main object of the invention is to provide a novel and improved directional radio antenna attachment for a transit to convert the transit for use with a directional radio beam transmitter so that the transit may be employed in conducting a terrestrial survey over terrain covered with timber or other growth making it impractical to conduct the survey in accordance with normal optical methods, the attachment being simple in construction, being easy to mount on a transit, and providing an accurate and relatively simple means for adapting the transit for use with a directional radio beam.

A further object of the invention is to provide an improved surveyor's transit provided with a radio beam receiving antenna so that the transit may be employed in conjunction with a directional beam radio transmitter to conduct a terrestrial survey over rough and wooded terrain under conditions wherein normal optical surveying technique cannot be employed.

A still further object of the invention is to provide an improved directional radio antenna attachment for a transit, said attachment involving relatively inexpensive components, being durable in construction, being easy to adjust to provide different arrangements of its elements, and being relatively compact in size and light in weight, whereby it may be easily transported or stored.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

Figure 1 is a front elevational view of a surveyor's transit provided with an improved directional radio antenna attachment according to the present invention.

Figure 2 is a side elevational view of the structure illustrated in Figure 1.

Figure 3 is an enlarged vertical cross sectional view taken on the line 3—3 of Figure 1.

Figure 4 is a perspective view showing the components of the directional radio antenna attachment of Figure 1, said components being shown in separated positions.

Referring to the drawings, 11 generally designates a conventional surveyor's transit mounted on the usual tripod 12, the transit including the usual leveling screws 13 which adjust the level of a lower plate 14, as indicated by the respective bubble level elements 15 and 16 mounted on plate 14. The plate 14 carries the upstanding vertical standards 17, 17 in the upper end portions of which are journaled the respective ends of the horizontal axle 18. The vertical circle 19 is likewise secured to the horizontal axle 18 in the usual manner. The transit telescope 20 is rigidly carried at the intermediate portion of horizontal axle 18. The table 14 is provided with the upper clamp screw 21, and the telescope is provided with the usual tangent screw 22, as shown.

Designated at 23 is a bracket member of inverted U-shape which is notched away at the ends of its side arms, as shown at 24, 24, the notched portions 24, 24 being engaged with opposite side portions of the horizontal axle 18, namely, portions located on opposite sides of the transit telescope 20 inwardly adjacent the top end portions of the standards 17, 17, the notched portions of said side arms being rigidly fastened to the horizontal axle 18 so that the bracket member 23 is secured in overlying transverse relation to the telescope 20 substantially in the same transverse vertical plane as the axle 18.

Integrally formed with the upper portion of the bracket member 23 is a transversely extending cross bar 25 to which is secured an output meter 26, said meter being connected to the output of a radio receiver 27 for indicating the response of the receiver in a manner presently to be described.

Rigidly secured on the top of the bight portion of bracket member 23 is a block element 28 which is formed with a dovetail groove 29 extending horizontally and transverse to the plane of the bracket member 23, as is clearly shown in Figure 4. Designated at 30 is an outrigger arm which is formed at its intermediate portion with a depending dovetailed lug 31 slidably receivable in the dovetail groove 29 with sufficient friction to securely fasten the outrigger arm 30 to the block 28. The dovetailed lug 31 extends transverse to the outrigger arm 30, so that the arm 30 will be secured to the block 28 in a horizontal position substantially in the same transverse vertical plane as the bracket member 23, said plane containing the axis of horizontal axle 18.

The outrigger arm 30 is formed at its opposite ends with respective dovetail grooves 32, 32 located symmetrically relative to the mid-point of the outrigger arm 30 and extending parallel to the dovetailed lug 31. The end portions of the arm 30 are likewise formed with additional dovetail grooves 33, 33 intersecting and being perpendicular to the dovetail grooves 32, 32, whereby the dovetail grooves 33, 33 are substantially in longitudinal alignment and are directed along a line contained in the transverse vertical plane containing the axis of horizontal axle 18.

Designated respectively at 34, 34 are identical loop antenna elements provided with depending supporting studs 35 to the bottom ends of which are rigidly connected dovetailed bar elements 36 which are slidably engageable in the dovetail grooves 32 or 33. As shown in Figure 4, the base bars 36 extend substantially in the same vertical plane as the respective associated loops 34. Thus, it will be apparent that the antenna loop elements 34, 34 may be mounted on the ends of the outrigger arm 30 either in positions extending perpendicular to the arm or in aligned transverse positions substantially in the same vertical plane as said arm. In the positions illustrated in Figures 1 and 2, the loop elements 34, 34 have their dovetailed base blocks 36 engaged in the dovetail grooves 32 whereby the loop elements 34, 34 are oriented in vertical planes parallel to each other but perpendicular to the outrigger arm 30.

The loop antenna elements 34, 34 are connected in opposition to the input of the radio receiver 27 so as to provide a zero input signal to the receiver when the loop antenna elements, arranged as illustrated in Figures 1 and 2, are oriented in the direction of an incoming directional radio beam.

The outrigger arm 30 is formed at its intermediate portion with a forwardly projecting lug 37 formed with a dovetail groove 38 extending parallel to the longitudinal direction of the arm 30 and is formed with a rearwardly projecting lug 39 formed with a dovetail groove 40 extending perpendicular to the direction of the arm.

Designated at 41 is an additional antenna loop element

provided with a depending stud 42 to which is rigidly secured a dovetail base bar 43 located substantially in the same plane as the loop element 41, the base bar 43 being receivable in either the groove 38 or the groove 40, depending upon the desired orientation of the loop element 41. Thus, as illustrated in Figures 1 and 2, the dovetail base bar 43 may be engaged in the dovetail groove 38, whereby the radio antenna loop element 41 will be oriented in a transverse vertical plane, parallel to the outrigger arm 30, namely, in a position to receive a maximum signal from a beam transmitter directed toward the transit 11. Alternatively, the base bar 43 may be engaged in the dovetail groove 40, whereby the loop antenna element 41 will be positioned transverse to the direction of the outrigger arm 30, namely, in a position to receive a minimum signal from a beam antenna directed toward transit 11.

The antenna element 41 is connected to the receiver 27 through a suitable change-over switch, the interconnected pair of previously mentioned loop antenna elements 34, 34 being likewise connected to the receiver through said switch, whereby either the center loop antenna element 41 or the interconnected balancing loop antenna elements 34, 34 may be selectively connected to the input of receiver 27, as desired by the transit man. The change-over switch may be mounted in any convenient location, for example, may be mounted on the panel of the receiver 27, as shown at 44 in Figure 1.

Any suitable transmitter may be employed with the apparatus, preferably a transmitter provided with a suitable directional antenna, as well as with a non-directional antenna, such as a conventional whip antenna, which may be substituted, as desired, for the directional antenna. With the antenna attachment mounted on the transit, as illustrated in Figures 1 and 2, the following method may be employed in developing a preliminary survey or base line in a situation where trees or other growth would prevent use of normal optical surveying technique: The instrument man sets up the transit 11 over the beginning point with the directional radio antenna attachment mounted thereon and connected to the receiver 27. The rodman proceeds to the first known point to be observed, places the transmitter at that point and energizes the transmitter with the radial or whip antenna connected thereto. The rodman then communicates with the transit man, employing conventional switch means on the transmitter provided for that purpose and instructs the transit man that the radial signal is now available. The transit man, after suitably leveling up the transit, energizes the receiver 27 and connects the intermediate receiving loop 41 to the input of the receiver. The transit man then swings the transit to a position which provides maximum signal on the indicating meter 26, employing the adjusting screws on the transit to swing the antenna loop element to the position of maximum reading. In this position the barrel of the telescope 20 is directed substantially along the line which it is desired to produce, said line connecting the two known points. For greater precision, the changeover switch 44 is operated, which connects the opposing loop antenna elements 34, 34 to the receiver input after which the adjusting screws of the transit are operated to further adjust the outrigger arm 30 to a position providing minimum or null reading on the output meter 26. The rodman is then instructed to employ the directional antenna of the transmitter and will adjust the transmitter antenna until the transit man is satisfied that an absolute null reading exists on the indicating meter 26.

At this point the attachment may be removed from the supporting bracket 23 and the survey may be carried forward in the conventional manner. When the transit man has performed the necessary ties along the first tangent and has arrived at a second point, the rodman is instructed to proceed to the next known point with the transmitter, and the survey progresses following the procedure previously described, utilizing the transit antenna attachment when required, but producing the line and turning the angles with the transit 11 in the conventional manner.

As will be readily apparent, the center antenna loop element 41 may be employed as a null indicator instead of a maximum signal indicator by mounting the loop element 41 in a plane perpendicular to the outrigger arm 30, namely, with the dovetail base bar 43 engaged in the dovetail groove 40. Similarly, the loop antenna elements 34, 34 may be oriented to provide maximum signal indications by suitably interconnecting them and engaging their dovetail base bars 36 in the dovetail grooves 33, 33 so that they are oriented in the same vertical plane as the outrigger arm 30.

It will be understood that both the transit man and the rod man are provided with suitable means for transmitting and receiving so that they may be in communication with each other. Thus, the rodman may be provided with a transceiver, so that he may receive as well as transmit, and the instrument man may be provided with a suitable transmitter, or alternatively, the receiver 27 may comprise a transceiver which may transmit as well as receive, such equipment being conventional and well known to those skilled in the art.

While a specific embodiment of an improved directional radio antenna attachment for a transit has been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. In combination with a transit having a horizontal axle and a telescope mounted on said horizontal axle, a bracket member secured to said horizontal axle in overlying transverse relation to said telescope, a horizontal outrigger arm detachably secured on the bracket member and extending equal distances on opposite sides thereof in the same vertical plane therewith, and a pair of identical loop antenna elements detachably secured on the opposite end portions of said outrigger arm and arranged symmetrically relative to said bracket member.

2. In combination with a transit having a horizontal axle and a telescope mounted on said horizontal axle, a bracket member secured to said horizontal axle in overlying transverse relation to said telescope, a horizontal outrigger arm detachably secured on the bracket member and extending equal distances on opposite sides thereof in the same vertical plane therewith, a pair of identical loop antenna elements detachably secured on the opposite end portions of said outrigger arm and arranged symmetrically relative to said bracket member, and an additional loop antenna element detachably secured on said outrigger arm substantially midway between said first-named loop antenna elements.

3. In combination with a transit having a horizontal axle and a telescope mounted on said horizontal axle, a bracket member secured to said horizontal axle in overlying transverse relation to said telescope, a horizontal outrigger arm detachably secured on the bracket member and extending equal distances on opposite sides thereof in the same vertical plane therewith, the end portions of said outrigger arm being formed with dovetail grooves arranged symmetrically relative to said bracket member, a pair of identical loop antenna elements, and respective dovetail base members supportingly secured to said loop antenna elements and being lockingly engageable in said dovetail grooves.

4. In combination with a transit having a horizontal axle and a telescope mounted on said horizontal axle, a bracket member secured to said horizontal axle in overlying transverse relation to said telescope, a horizontal outrigger arm detachably secured on the bracket member and extending equal distances on opposite sides thereof in the same vertical plane therewith, a pair of identical

loop antenna elements detachably secured on the opposite end portions of said outrigger arm and arranged symmetrically relative to said bracket member, the outrigger arm being formed with an additional dovetail groove located midway between said first-named groove, an additional loop antenna element, and a dovetail base member supportingly secured to said additional loop antenna element and being lockingly engageable in said last-named dovetail groove.

5. In combination with a transit having a horizontal axle and a telescope mounted on said horizontal axle, a bracket member secured to said horizontal axle in overlying transverse relation to said telescope, a horizontal outrigger arm detachably secured on the bracket member and extending equal distances on opposite sides thereof in the same vertical plane therewith, the end portions of said outrigger arm being formed with parallel dovetail grooves arranged symmetrically relative to said bracket member, a pair of identical loop antenna elements, respective dovetail base members supportingly secured to said loop antenna elements and being lockingly engageable in said dovetail grooves, the outrigger arm being formed with an additional dovetail groove located midway between said first-named grooves and directed perpendicular to the direction of said first-named grooves, an additional loop antenna element, and a dovetail base member supportingly secured to said additional loop antenna element and being lockingly engageable in said last-named dovetail groove.

6. In combination with a transit having a horizontal axle and a telescope mounted on said horizontal axle, a bracket member of inverted U-shape secured to opposite side portions of said horizontal axle in overlying transverse relation to said telescope, an indicating meter mounted on the upper portion of said bracket member subjacent its bight portion, a horizontal outrigger arm detachably secured on the bight portion of the bracket member and extending equal distances on opposite sides thereof in the same vertical plane therewith, the end portions of said outrigger arm being formed with dovetail grooves arranged symmetrically relative to said bracket member, a pair of identical loop antenna elements, respective dovetail base members supportingly secured to said loop antenna elements and being lockingly engageable in said dovetail grooves, the outrigger arm being formed with an additional dovetail groove located midway between said first-named groove, an additional loop antenna element, and a dovetail base member supportingly secured to said additional loop antenna element and being lockingly engageable in said last-named dovetail groove.

7. In combination with a transit having a horizontal axle and a telescope mounted on said horizontal axle, a bracket member of inverted U-shape secured to opposite side portions of said horizontal axle in overlying transverse relation to said side portions of said horizontal axle in overlying transverse relation to said telescope, an indicating meter mounted on the upper portion of said bracket member subjacent its bight portion, a horizontal outrigger arm detachably secured on the bight portion of the bracket member and extending equal distances on opposite sides thereof in the same vertical plane therewith, the end portions of said outrigger arm being formed with parallel dovetail grooves arranged symmetrically relative to said bracket member, a pair of identical loop antenna elements, respective dovetail base members supportingly secured to said loop antenna elements and being lockingly engageable in said dovetail grooves, the outrigger arm being formed with an additional dovetail groove located midway between said first-named grooves and directed perpendicular to the direction of said first-named grooves, an additional loop antenna element, and a dovetail base member supportingly secured to said additional loop antenna element and being lockingly engageable in said last-named dovetail groove.

8. In combination with a surveying instrument of the type having a horizontal axle and including a telescope mounted on said horizontal axle, a directional radio antenna including a pair of identical loop elements, and means secured to said horizontal axle in transverse overlying relation to said telescope and supporting said antenna on the instrument with said loop elements disposed in symmetrical relation to the axis of said telescope.

9. In combination with a surveying instrument of the type having a horizontal axle and including a telescope mounted on said horizontal axle, a directional radio antenna having a directional axis, and means secured to said horizontal axle in transverse overlying relation to said telescope and supporting said antenna on said instrument with said directional axis extending substantially in the same direction as the optical axis of said telescope.

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