Sept. 4, 1956 M. E. AMDURSKY ET AL 2,761,990

COLOR TELEVISION IMAGE REPRODUCER

Filed Feb. 19, 1954 2 Sheets-Sheet 1

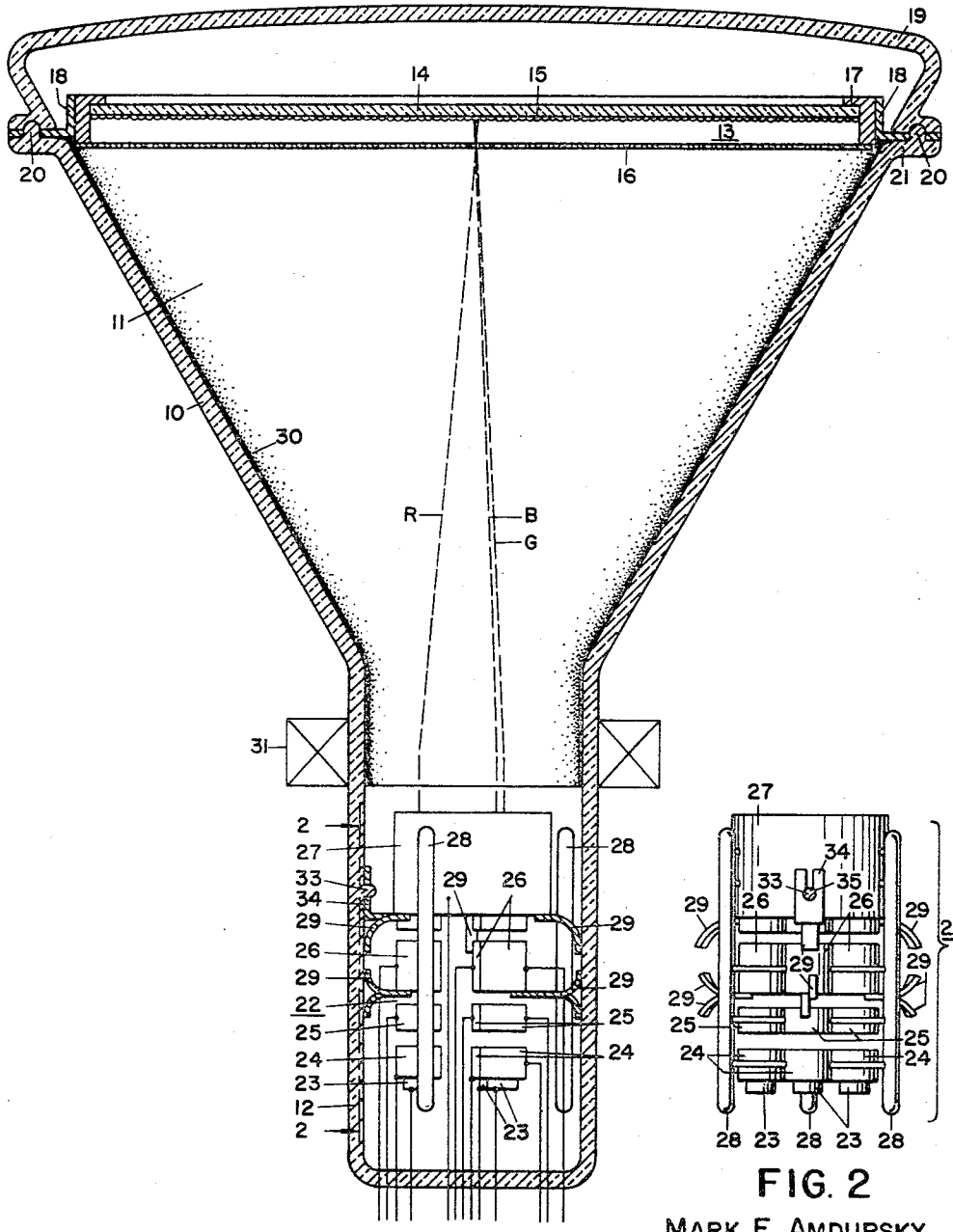

FIG. 1

FIG. 2

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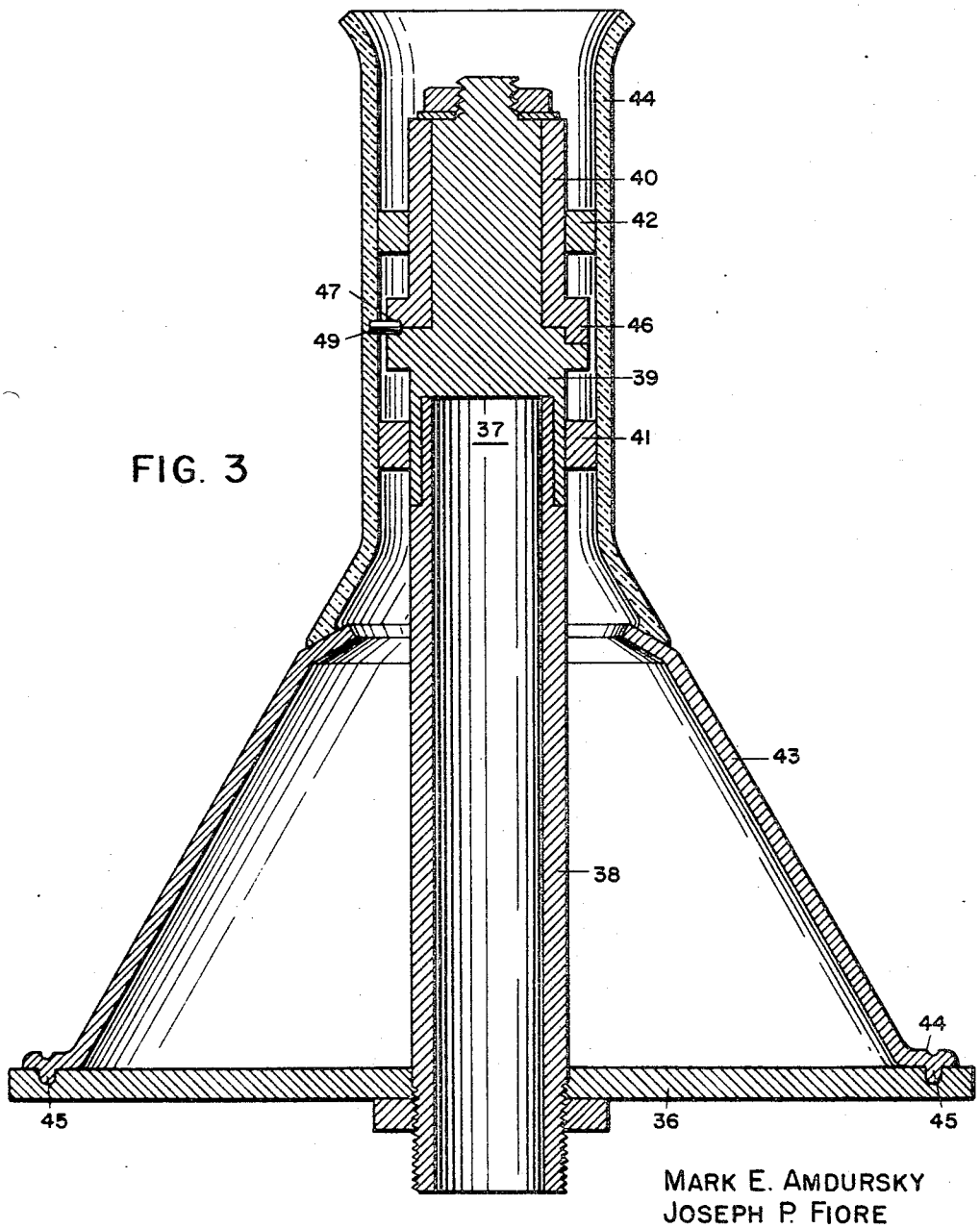
FIG. 3



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COLOR TELEVISION IMAGE REPRODUCER

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3 Claims. (Cl. 313—70)

This invention pertains to a new and improved color-television image reproducer of the type comprising a direction-sensitive color target and means for generating a plurality of electron beams to excite that target.

Several different types of image reproducers have been considered for use in color television receivers. Certain of these reproducers employ direction-sensitive fluorescent screens or targets excited by a plurality of electron beams which impinge upon the target from different angles, color response being determined by the angle of incidence of each beam with respect to the target. Picture tubes of this general type are characterized by the fat that accurate color reproduction is dependent upon precise location of the electron guns with respect to the screen. In order to reproduce an image with the proper color and tone values, the electron guns must be accurately spaced from the target and must be placed in proper angular orientation with respect to the target. Thus, in a tri-color dot-type image reproducer, in which the target comprises a multiplicity of minute areas or dots of different color phosphors, the guns must be accurately spaced from the screen and should be accurately oriented with respect to the rows of color dots and the arrangement of the color dots within those rows. The same requirements for precision, in one direction, are presented by a line-type screen.

Heretofore, it has been customary to fabricate and assemble the envelope and target of this type of color-image reproducer, after which the multiple electron gun assembly is mounted in the tube and aligned with the target by means of time-consuming and difficult optical or mechanical techniques. The electron-gun assembly may then be sealed into the tube and further manufacturing processes completed. Often, the electron-gun assembly and the tube envelope are marked to permit replacement of the gun assembly at a later date; however, marking techniques have proved undesirably inaccurate. Consequently, it is extremely difficult to salvage image reproducers in which one or more electron guns do not perform satisfactorily on test. In addition, the original mounting alignment technique is undesirably costly when applied to the manufacture of a large number of tubes.

It is an object of the invention, therefore, to provide a new and improved color-television image reproducer adapted to efficient and automatic alignment of an electron-gun assembly with respect to a direction-sensitive target.

It is another object of the invention to provide a new and improved multiple-gun color-television tube of standardized design in which the electron-gun assembly may be readily replaced without adversely affecting operation of the tube.

It is a corollary object of the invention to provide a new and improved color-television image reproducer which is relatively simple and expedient to construct and economical to manufacture.

A color-television image reproducer constructed in accordance with the invention comprises an evacuated envelope and a direction-sensitive color target; the color target includes a plurality of groups of color target areas arranged in a predetermined pattern across one end of the envelope, each of these groups having a distinctive color radiation characteristic in response to electron bombardment. An electron-gun assembly, located at the opposite end of the envelope, is employed to project a plurality of electron beams to impinge upon the color target. A bifurcated extension member having an indexing receptacle is included in the electron-gun assembly. An index member is affixed to and extends internally of the reproducer envelope; this index member engages the indexing receptacle to maintain the assembly at a predetermined distance from the color target. In addition, the index member maintains the electron-gun assembly in predetermined angular orientation with respect to the target.

The features of the invention which are believed to be novel are set forth with particularity in the appended claims. The organization and manner of operation of the invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals indicate like elements in the several figures, and in which:

Figure 1 is a fragmentary cross-sectional view, partially schematic, of a color-television image reproducer constructed in accordance with the invention;

Figure 2 is a view of the electron-gun assembly of the image reproducer taken along line 2—2 in Figure 1;

Figure 3 is a cross-sectional view illustrating a step in the manufacture of an image reproducer constructed in accordance with another embodiment of the invention.

The color-television image reproducer illustrated in Figure 1 comprises an envelope 10 including an enlarged bulb or faceplate section 11 and a neck portion 12; faceplate section 11 has been partially cut away in order to reduce the overall size of the figure. A direction-sensitive color target 13 is mounted transversely of the faceplate portion of the envelope. Target 13 comprises a transparent screen base 14, which may be constructed from glass or other suitable material, a plurality of groups of color target areas 15 deposited on the side of base 14 facing neck 12, and a parallax barrier 16 interposed between target areas 15 and the neck of the tube. Usually, a conductive layer (not shown) of aluminum or the like is placed over the entire phosphor coated area and maintained at final anode potential to provide maximum brightness in the reproduced image. Base 14 and parallax barrier 16 are each affixed to a mounting ring 17, preferably formed from stainless steel or other suitable conductive material, and ring 17 is supported within envelope 10 by means of a plurality of support elements or brackets 18 suitably sealed to bulb section 11 and to a transparent faceplate closure member 19. The configuration of color target areas 15 may be different for different types of tubes; for example, the color target areas may comprise minute circular areas or dots of phosphor material or may comprise a series of narrow elongated strips of color phosphors. In either type of screen arrangement, the target areas are arranged in a predetermined pattern upon base member 14 and comprise a plurality of interspersed similar groups of different types of phosphor, each of the groups having a distinctive color radiation characteristic in response to electron bombardment. In the usual tri-color image reproducer, three groups of target areas which respectively radiate light corresponding to the additive primary colors red, blue and green are employed. It should be noted that the structural details of the direction-sensi-

tive target are of little or no importance in relation to the present invention; for example, target areas **15** may be deposited on the inner surface of faceplate **19**, in which case parallax barrier **16** may be shaped to have the same configuration as the faceplate, and screen base **14** may be omitted. Or the target may comprise a multiplicity of pyramidal target areas having different color phosphors coated on different faces of each of the pyramids, in which case parallax barrier **16** may be omitted.

The position of target **13** within bulb section **11** is determined by a plurality of index or location elements **20** preferably formed as an integral part of the flange **21** of bulb portion **11** which is sealed to closure member **19**. Prior to assembly, mating index apertures are formed in each of brackets **18** and a similar number of grooves or receptacles are formed in faceplate **19** so that when the image reproducer is assembled and faceplate **19** is sealed to flange **21** of bulb portion **11**, target **13** is held in a fixed predetermined position within bulb section **11**.

An electron-gun assembly **22** is mounted within neck **12**; gun assembly **22** comprises means for projecting a plurality of electron beams toward target **13** and, in a typical tri-color tube, may include three individual electron guns. Preferably, the three guns are substantially identical to each other in structure, and each may include a cathode **23**, a first control electrode **24**, a second control electrode **25**, and a focus electrode or first anode **26**. A common final electrode for the three guns, convergence electrode **27**, is included in the electron-gun assembly. The individual electrodes of assembly **22** are maintained in alignment with each other by means of a plurality of support rods **28**, which may be formed from glass or similar suitable insulating material. The complete assembly may be centered within neck **12** in conventional manner by means of a plurality of resilient retaining members **29**, which may be affixed to various elements of assembly **22**; in the illustrated embodiment, the retaining members are mounted on convergence electrode **27** and on focus electrodes **26**. It will be understood that electromagnetic or mechanical convergence systems may be employed without departing from the invention in any way, in which case convergence electrode **27** is not employed and all of the retaining members are preferably mounted on the individual gun electrodes.

An electrically conductive coating **30** of colloidal graphite or the like is formed on the internal surface of bulb section **11** and extends from target **13** into the portion of neck section **12** adjacent convergence electrode **27**. A conventional electromagnetic scanning yoke **31** is associated with the image reproducer and is mounted externally of neck section **12** intermediate gun assembly **22** and target **13**. Individual leads may be provided for each of the electrodes of gun assembly **22** to facilitate the application of appropriate operating potentials and modulating signals to the various electrodes of the three guns; these leads have been illustrated schematically in order to avoid overcrowding of the figure.

As thus far described, the image reproducer of Figure 1 is entirely conventional in construction and operation, so that a detailed description of how the tube functions is deemed unnecessary. Briefly, when the tube is placed in operation the three electron guns included in assembly **22** generate three individual electron beams and project those beams toward target **13**. The three beams are indicated by dash lines R, B and G. Beams R, B and G are converged by an electrostatic lens formed between conductive coating **30** and convergence electrode **27** so that they converge upon a common point approximately in the plane of parallax barrier **16** and diverge slightly before impinging upon target areas **15**. Parallax barrier **16** serves to differentiate between the three beams according to the angle at which they impinge upon the target so that beam R, for example, strikes only those target areas **15** which emit red light in response to electron bombardment. Similarly, beams B and G are restricted by the parallax barrier so that they can impinge only on the target areas which emit green and blue light respectively. The beams as a group are deflected across target **13** by means of deflection signals applied to yoke **31** to scan an image raster.

Because target **13** is direction-sensitive, that is to say because the color response of the target to electron bombardment is dependent on the angle of incidence of the bombarding electrons, gun assembly **22** must be fixed in accurately predetermined angular orientation with respect to target **13**. Otherwise, colors in the reproduced image may be substantially distorted so that correct color reproduction is impossible. Moreover, gun assembly **22** must be spaced from the target by a predetermined distance in order that the three beams may converge upon target **13** from the proper angles for accurate color selection. As indicated above, conventional practice requires that the electron-gun assembly for a given tube be individually aligned with respect to its target by optical or mechanical methods, a time consuming and expensive operation. Moreover, where conventional practice is employed, replacement of a defective electron-gun assembly, as may be occasioned in salvaging rejects, requires repetition of the entire alignment procedure. In the tube of Figure 1, these difficulties are overcome in accordance with the invention by means of an indexing alignment structure for the electron-gun assembly.

During manufacture of envelop **10**, a relatively small index member or pin **33** is affixed to neck **12** so that it extends internally of the envelope in predetermined angular and spaced relationship with respect to location elements **20** of bulb section **11**. Preferably, pin **33** is formed as an integral part of the glass envelope. Gun assembly **22**, on the other hand, is modified to include a pin-engaging element **34** which is adapted to engage pin **33** and thus fix gun assembly **22** at a predetermined distance from and in predetermined angular orientation with respect to the target. Member **34** may comprise a bracket affixed to convergence electrode **27**. A preferred configuration for the pin-engaging member is shown in Figure 2. As illustrated therein, member **34** is of bifurcated construction and includes a slightly enlarged pin receptacle **35** at the bight end of the bifurcation. Extension **34** is preferably formed from somewhat resilient material so that when gun assembly **22** is mounted in neck **12** it may be aligned with pin **33** and then forced toward target **13** until pin **33** seats in receptacle **35**. Thus, the electron-gun assembly is held in proper alignment with respect to the target by means of the index pin.

In the assembly of an image reproducer constructed in accordance with the invention, the conventional steps of precision optical or mechanical alignment of the gun assembly with respect to the target are completely eliminated. Accordingly, production may be standardized and simplified to a substantial extent. More importantly, if, after final processing and evacuation, some elements of the electron-gun assembly prove defective, it is a relatively simple matter to cut off a portion of neck **12**, remove electron gun assembly **22**, and immediately replace the electron gun assembly with a similar unit. It is no longer necessary to repeat the painstaking precision alignment procedure with the replacement gun assembly, since it may be accurately oriented within the tube neck by merely engaging member **34** with the index pin **33** on the replacement gun assembly. A new neck extension may then be sealed onto the tube and the image reproducer is ready to be evacuated and placed in operation.

The embodiment of Figure 1 illustrates a preferred form of the invention as applied to an all-glass envelope. Many tubes, however, employ a composite metal-glass envelope in which most of bulb portion **11** is formed from some suitable metal to which are sealed a glass faceplate and a glass neck section. Because it is not generally possible to determine just how thick the seal between the glass neck section and metal portion of the tube will be,

and since changes in this thickness may result in a variation of the spacing between given points on the neck wall and the position which the target will occupy in the tube, a preformed index member corresponding to pin 33 of Figure 1 is not particularly desirable. Figure 3 illustrates a preferred method of locating an index pin within the tube neck for glass-metal envelopes of this type.

The apparatus illustrated in Figure 3 comprises a jig base 36 on which is mounted an alignment jig 37. Jig 37 may comprise a support tube 38, a first jig member 39 mounted on tube 38 in predetermined spaced relation to base 36, and a second jig member 40 which is detachably mounted on member 39. Jig member 40 is keyed to jig member 39 by means of a key 46 so that the two jig members may be fitted together in only one position. A receptacle 47 is formed at the junction of the two jig members and may comprise a small hole centered at the junction plane of the two jig members. A pair of carbon mounting rings 41 and 42 are mounted in encompassing relation to jig members 39 and 40 respectively.

The envelope for this particular type of tube comprises a metallic bulb or cone section 43 and a glass neck section 44 which has been sealed to cone 43. Cone 43 terminates in a sealing flange 44 to which a suitable faceplate is to be sealed; a plurality of location pins or extensions 45 corresponding to elements 20 of Figure 1 are formed in sealing flange 44 to provide for orientation of the target of the tube.

After neck section 44 has been sealed to cone 43, the composite envelope is installed on the jig in the position illustrated in the drawing, with extensions 45 seated in receptacles formed in jig base 46 so that the envelope is in fixed angular orientation with respect to jig 37. It should be noted that the outside diameter of carbon rings 41 and 42 should accurately conform to the internal diameter of neck section 44 so that the envelope is firmly seated on jig 37. A small metallic pin 49 is then preheated to a temperature high enough to melt the glass of neck 44 and is forced through the glass and into pin receptacle 47 of the jig. Alternatively, neck 44 may be locally heated adjacent receptacle 47 and a small hole blown through the neck wall; pin 49 is then inserted into the receptacle. The diameter of pin 49 should conform to the internal diameter of receptacle 47 so that the pin is precisely located in neck 44. As indicated in the drawing, it is preferred that the locally melted glass of neck 44 be permitted to flow over pin 49 so that the pin is electrically insulated from the external portion of the tube. Neck section 44 is then annealed, after which jig member 40 is detached from member 39 and removed from neck section 44. The envelope may then be removed from jig 37 and the remainder of the tube may be assembled as indicated in connection with Figure 1.

The indexing structure for the composite metal-glass envelope constructed as described in connection with Figure 3 is as accurate and effective in aligning the electron-gun assembly of the color image reproducer as the all-glass construction illustrated in Figure 1. The original fabrication of the tube is greatly simplified as compared to the prior art and replacement of a defective electron gun assembly is made possible without resorting to expensive and difficult optical alignment procedures. Moreover, electron-gun assemblies may be constructed to be interchangeable for use with either type of envelope.

While particular embodiments of the present invention have been shown and described, it is apparent that changes and modifications may be made without departing from the invention in its broader aspects. The aim of the appended claims, therefore, is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

We claim:

1. A color-television image reproducer comprising: an evacuated envelope; a direction-sensitive color target comprising a plurality of groups of color target areas arranged in a predetermined pattern across one end of said envelope, each of said groups having a distinctive color radiation characteristic in response to electron bombardment; an electron-gun assembly, located at the opposite end of said envelope, for projecting a plurality of electron beams to impinge upon said target; a bifurcated extension member, included in said gun assembly, having an indexing receptacle; and an index member, affixed to and extending internally of said envelope, for engaging said indexing receptacle to maintain said assembly at a predetermined distance from and in predetermined angular orientation with respect to said target.

2. A color-television image reproducer comprising: an evacuated envelope including an enlarged faceplate portion and a neck portion; a direction-sensitive color target comprising a plurality of groups of color target areas arranged in a predetermined pattern across said faceplate portion of said envelope, each of said groups having a distinctive color radiation characteristic in response to electron bombardment; an electron-gun assembly, mounted within said neck portion of said envelope, for projecting a plurality of electron beams to impinge upon said target; a bifurcated extension member, included in said gun assembly, having an indexing receptacle; and an index member, affixed to and extending internally of said neck portion of said envelope, for engaging said indexing receptacle to maintain said assembly at a predetermined distance from and in predetermined angular orientation with respect to said target.

3. A color-television image reproducer comprising: an evacuated envelope; a direction-sensitive color target comprising a plurality of groups of color target areas arranged in a predetermined pattern across one end of said envelope, each of said groups having a distinctive color radiation characteristic in response to electron bombardment; an electron-gun assembly, located at the opposite end of said envelope, for projecting a plurality of electron beams to impinge upon said target, said assembly comprising a plurality of individual electron guns corresponding in number to said plurality of groups of color target areas, and a common final electrode for said guns; a bifurcated extension member rigidly affixed to said final electrode and having an indexing receptacle; and an index member, affixed to and extending internally of said envelope, for engaging said indexing receptacle to maintain said assembly at a predetermined distance from and in predetermined angular orientation with respect to said target.

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