

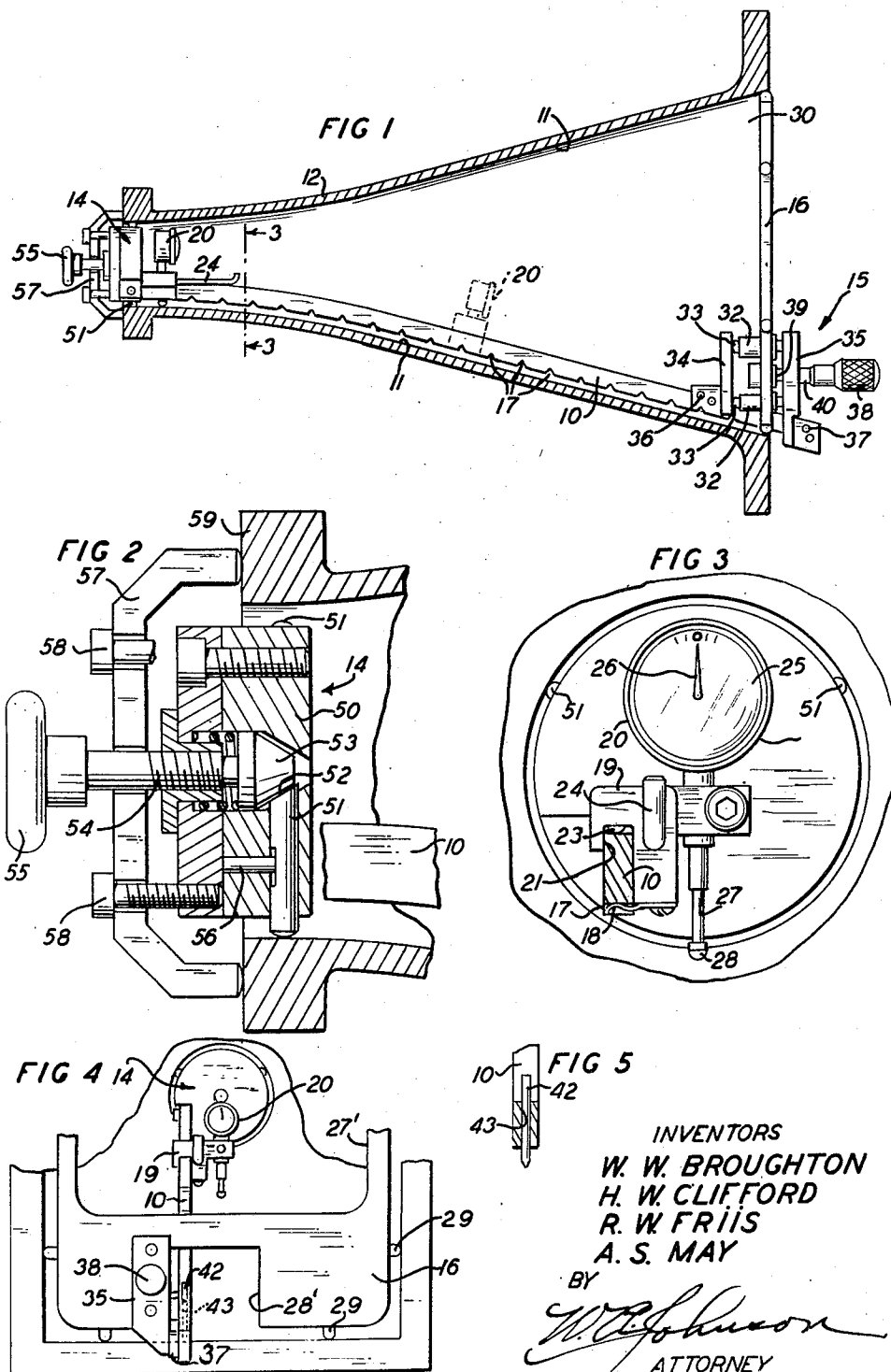
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APPARATUS FOR GAGING HORN STRUCTURES

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1

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APPARATUS FOR GAGING HORN STRUCTURES

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This invention relates to apparatus for gaging horn structures particularly antenna feed horns of microwave communication equipment.

Antenna feed horns of microwave communication equipment are initially cast of a suitable metal such as aluminum with inner, presumably like, surfaces flaring outwardly from the throat thereof to the mouth of the horn and provided initially with excess overall lengths embodied particularly in extra thick portions adjacent the mouth and throat. Horns of this type have throats of circular internal cross-sectional contours, mouths of square cross-sectional internal contours and surfaces beginning with the circular contours of the throats and merging into cross-sectionally flat surfaces tapering toward their respective top, bottom and sides of the mouth. To function most efficiently, the contours of the surfaces between the throat and the mouth of each horn are important and the measurements of the various portions of these surfaces extending from the mouth to the throat must be within predetermined limits.

The object of the present invention is an apparatus for accurately gaging horns. According to the object one embodiment of the invention includes a gage unit movable in a predetermined path and having a pointer held on a zero position by a feeler when portions of the surfaces engaged by the feeler are of a desired known contour and movable relative to the zero position by the feeler to indicate variations of the surface portions from the known contour. Also an elongate element has a gaging area of a contour to support the unit for movement in predetermined paths relative to each surface being gaged.

In the present embodiment of the invention, the apparatus includes a spider adapted to be disposed in the mouth of the horn to locate the element with a gage unit adjacent one of the surfaces thereof and to support an adjustable mounting for the element whereby the element may be moved longitudinally relative to the spider and the surface to be gaged until the most desirable location has been reached wherein the contour of the surface in the gaging area of the element most closely corresponds to the known contour. During the initial setting of the element with respect to the spider and the surface being gaged, exploratory gaging operations with the gage unit may be performed to select the preferred position of the element with respect to the surface. A clamping unit disposed in the throat of the horn supports the adjacent end of the element for movement until the final position thereof has been selected after which the unit may be actuated to secure the entire apparatus in the horn.

Other objects and advantages will be apparent from the following detailed description when considered in conjunction with the accompanying drawing, wherein:

Fig. 1 is a side elevational view of the apparatus shown mounted in a horn being gaged;

Fig. 2 is an enlarged vertical sectional view of the holding unit in the throat of the horn;

2

Fig. 3 is an enlarged vertical sectional view taken substantially along the line 3—3 of Fig. 1;

Fig. 4 is a fragmentary front elevational view of the apparatus mounted in the horn, and

Fig. 5 is an enlarged fragmentary sectional view of the marking element of the apparatus.

In the present embodiment of the invention, the apparatus includes an elongate element 10 having a contour corresponding to that desired for inner surfaces 11 of a horn 12. The left end of the element 11 is supported by a clamping unit 14 while the right end of the element is supported by an adjusting means indicated generally at 15 supported by a spider 16. Inverted V-shaped notches 17 formed in the lower edge of the element 10 serve to receive a spring 18 (Fig. 3) of a carriage 19 for a gaging unit 20. The carriage 19 is grooved at 21 to straddle the element 10 and has one or more semi-spherical elements 23 mounted in the top of the groove 21 to ride on the upper surface of the element. If desired, the members 23 may be rotatable ball-like members to reduce the frictional contact between the carriage 19 and the element 10 to a minimum. A handle 24 for the carriage 19 extends forwardly and has its leading end bent upwardly to permit the operator to move the carriage in either direction to any one of the gaging positions represented by the notches 17 where the spring 18 would function to hold the unit temporarily. The gaging unit 20 may be of a commercially known type including a graduated dial 25 and a rotatable pointer 26 actuated through the conventional mechanism by a spring actuated plunger or feeler 27 having a contact end 28 adapted to ride on the surface being gaged.

The spider 16 has an outer surface substantially square with rounded corners (shown in Fig. 4) including openings 27' and 28' to facilitate movement of the carriage 19 and its gaging unit 20 and permitting the operator to readily read the gage. A desired number of pins 29 with rounded ends are mounted in the various sides of the spider so that the spider may enter the mouth 30 of the horn 12 and be located accurately therein. It is desirable that the spider be located within the mouth but adjacent the outer face of the horn but this positioning of the spider is not of vital importance in that the element 10, particularly its supporting unit 15 is adjustable relative to the spider.

The adjustable supporting means 15 for the element 10 includes bushings 32 fixedly mounted in apertures in the spider to receive parallel rods 33 having their ends fixedly mounted in apertures of brackets 34 and 35. The lower ends of the brackets are fixed at 36 and 37 to the element 10 in such a manner, illustrated in Fig. 4, that the brackets will not interfere with the travel of the gaging unit 20 and its carriage 19. A micrometer structure 38 having an inner portion 39 fixed to the spider 16 and an outer portion 40 fixed to the bracket 35 permits fine adjustment of the element 10 through its supporting means 15 relative to the adjacent surface 11 of the horn. The micrometer is used for fine adjustments of the element and to lock the element against accidental movement, and not as a measuring means. However, it can be used as a reference setting for gaging future like horns. With reference to Figs. 4 and 5, it will be noted that a center punch 42, is removably disposed in an aperture 43 in the element 10 at the last gaging position and is in use only after the last gaging operation to be forced downwardly to mark the position in the mouth of the horn to which the mouth of the horn is to be machined.

The unit 14 includes a body 50 having the adjacent end 51 of the element 10 fixed thereto and provided with radially extending pins 51 in apertures thereof with their tapered inner surfaces 52 engaging a conical member 53 which serves as a cam actuated by a threaded shaft 54,

3

on which it is mounted, during rotation of a hand wheel 55. The pins 51 are held against rotation by pin-like members 56 entering notches in adjacent surfaces of the pins 51 to keep the tapered surfaces 52 in proper alignment with the member 53. A yoke 57 is removably attached to the body 50 by threaded elements 58 engaging the adjacent end 59 of the horn to lock the unit 14 in the selected position desired for the element 10.

The operation of the apparatus begins with positioning the apparatus initially in a horn with the element 10 adjacent the first surface 11 thereof to be gaged. At this time the spider will be firmly although removably mounted in the mouth of the horn and the micrometer unit 38 set at its zero position, locating the last notch 17 of the element 10, representing the last gaging position, in a plane with the pins 29 of the spider 16. With the aid of the gage unit 20, the element may be adjusted inwardly through actuation of the micrometer unit to find the preferred location for the element 10. With the unit 14 free to ride in the throat of the horn on the rounded ends of the pins 51, exploratory readings may be taken by moving the carriage 19 with the unit 20 to any selected position on the element, preferably in the larger areas of the horn, to determine the adjustment necessary for the element and to position it so that the path of the feeler 27 of the unit 20 will most closely correspond to the contour of the surface being gaged. When this condition has been accomplished, the unit 14 is actuated into the position shown in Fig. 2 by operating the handle 55 on the threaded element to cause the conical member 53 to move the pin 51 outwardly to engage the throat of the horn, automatically centering the unit 14 in the throat of the horn and cooperating with the spider to position the element 10 a known distance from the preferred area for the surface to be gaged. This may be described as a preferred line of a contour identical with the contour of the element so that, as the gaging unit 20 is moved with its carriage to the successive positions represented by the notches 17, the gage will indicate any variation one way or the other from this line. If any of the surfaces or portions of the surfaces of the horn are beyond the predetermined limits required, the horn will be rejected. However, if the surfaces when gaged are within the predetermined limits, the center punch 42 is actuated through the aperture 43 to mark the mouth of the horn so that subsequently the mouth of the horn may be machined back to the marks. Later the overall length of the horn may be reduced to the measurement desired by removing excess material from the portion 59 of the throat of the horn.

After the adjustment of the element 10 has been made for the first surface of the horn it is presumed that this adjusted position will be the preferred position of the element for each of the other surfaces 11 to be gaged. This may be accomplished by turning the horn to locate another surface 11 at the bottom of the horn, loosening the unit 14 sufficiently to allow movement of the apparatus outwardly to free the spider 16 for movement into the new position adjacent the next surface 11 to be gaged. These actions of the apparatus are continued until all four surfaces of the horn have been gaged and marked by the punch 42, after which the apparatus is removed from the horn and the machining steps are carried to completion. It is not believed necessary to illustrate the machining as they may be carried out in a conventional grinding or milling machine, first reducing the thickness of the mouth to the marks on the surfaces and then reducing the thickness of the throat to reduce the overall length of each horn to the predetermined measurement.

It is to be understood that the above described arrangements are simply illustrative of the application of the principles of the invention. Numerous other arrangements may be readily devised by those skilled in

4

the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. An apparatus for gaging surfaces of horns which must conform within given limits to known contours in flaring outwardly from throats of the horns to mouths thereof and which are provided initially with excess overall lengths embodied in extra thick throat and mouth portions of the horns, the apparatus comprising a supporting member movably disposed in the throats of the successive horns, a spider removably disposed successively in the mouths of the horns, a gage unit having a pointer normally urged below a reference position on a dial and actuable by a feeler for movement to and above the reference position, and an elongate element having its ends supported respectively by the member and the spider and its intermediate portion having spaced gaging positions in a gaging area of a contour corresponding to the known contour disposed by the member and spider adjacent successive surfaces to be gaged and supporting the gage unit for sliding movement thereon whereby the feeler will move the pointer to the reference position and hold it there while the gaging unit slides from one gaging position to another through the gaging area of the element relative to a surface of the known contour and the feeler will move the pointer to positions relative to the reference position to indicate variations of a surface being gaged from the known contour.

2. An apparatus for gaging surfaces of horns which must conform within given limits to known contours in flaring outwardly from throats of the horns to mouths thereof and which are provided initially with excess overall lengths embodied in extra thick throat and mouth portions of the horns, the apparatus comprising a supporting member movably disposed in the throats of the successive horns, a spider removably disposed successively in the mouths of the horns, a gage unit having a pointer normally urged below a reference position on a dial and actuable by a feeler for movement to and above the reference position, and an elongate element having its ends supported respectively by the member and the spider and its intermediate portion having spaced gaging positions in a gaging area of a contour corresponding to the known contour disposed by the member and spider adjacent successive surfaces to be gaged and supporting the gage unit for sliding movement thereon whereby the feeler will move the pointer to the reference position and hold it there while the gaging unit slides from one gaging position to another through the gaging area of the element relative to a surface of the known contour and the feeler will move the pointer to positions relative to the reference position to indicate variations of a surface being gaged from the known contour, and means carried by the spider to move the element longitudinally in the horn relative to the spider and with the member until the gaging area of the element registers with a selected area of the surface to be gaged which most closely corresponds to the known contour.

3. An apparatus for gaging surfaces of horns which must conform within given limits to known contours in flaring outwardly from throats of the horns to mouths thereof and which are provided initially with excess overall lengths embodied in extra thick throat and mouth portions of the horns, the apparatus comprising a supporting member movably disposed in the throats of the successive horns, a spider removably disposed successively in the mouths of the horns, a gage unit having a pointer normally urged below a reference position on a dial and actuable by a feeler for movement to and above the reference position, an elongate element having its ends supported respectively by the member and the spider and its intermediate portion having spaced gaging positions in a gaging area of a contour corresponding to the known

5

contour disposed by the member and spider adjacent successive surfaces to be gaged and supporting the gage unit for sliding movement thereon whereby the feeler will move the pointer to the reference position and hold it there while the gaging unit slides from one gaging position to another through the gaging area of the element relative to a surface of the known contour and the feeler will move the pointer to positions relative to the reference position to indicate variations of a surface being gaged from the known contour, and means carried by the spider to move the element longitudinally in the horn relative to the spider and with the member intermediate exploratory gaging operations of the unit at selected gaging positions until the gaging area of the element registers with a selected area of the surface to be gaged which most closely corresponds to the known contour.

4. An apparatus for gaging surfaces of horns which must conform within given limits to known contours in flaring outwardly from throats of the horns to mouths thereof and which are provided initially with excess overall lengths embodied in extra thick throat and mouth portions of the horns, the apparatus comprising a supporting member movably disposed in the throats of the successive horns, a spider removably disposed successively in the mouths of the horns, a gage unit having a pointer normally urged below a reference position on a dial and actuable by a feeler for movement to and above the reference position, an elongate element having its ends supported respectively by the member and the spider and its intermediate portion having spaced gaging positions in a gaging area of a contour corresponding to the known contour disposed by the member and spider adjacent successive surfaces to be gaged and supporting the gage unit for sliding movement thereon whereby the feeler will move the pointer to the reference position and hold it there while the gaging unit slides from one gaging position to another through the gaging area of the element relative to a surface of the known contour and the feeler will move the pointer to positions relative to the reference position to indicate variations of a surface being gaged from the known contour, means carried by the spider to move the element longitudinally in the horn relative to the spider and with the member until the gaging area of the element registers with a selected area of the surface to be gaged which most closely corresponds to the known contour, and means carried by the element, movable therewith during the selection of the area of the surface to be gaged and movable relative thereto to mark the beginning of the surface to be gaged.

5. An apparatus for gaging surfaces of horns which must conform within given limits to known contours in flaring outwardly from throats of the horns to mouths thereof and which are provided initially with excess overall lengths embodied in extra thick throat and mouth portions of the horns, the apparatus comprising a supporting member movably disposed in the throats of the successive horns, a spider removably disposed successively in the mouths of the horns, a gage unit having a pointer normally urged below a reference position on a dial and actuable by a feeler for movement to and above the reference position, an elongate element having its ends supported respectively by the member and the spider and its intermediate portion having spaced gaging positions in a gaging area of a contour corresponding to the known contour disposed by the member and spider adjacent successive surfaces to be gaged and supporting the gage unit for sliding movement thereon whereby the feeler will move the pointer to the reference position and hold it there while the gaging unit slides from one gaging position to another through the gaging area of the element relative to a surface of the known contour and the feeler will move the pointer to positions relative to the reference position to indicate variations of a surface being gaged from the known contour, means carried by the spider to

6

move the element longitudinally in the horn relative to the spider and with the member intermediate exploratory gaging operations of the unit at selected gaging positions until the gaging area of the element registers with a selected area of the surface to be gaged which most closely corresponds to the known contour, and means carried by the element, movable therewith during the selection of the area of the surface to be gaged and movable relative thereto to mark the excess overall length to be removed from the horn.

6. An apparatus for gaging surfaces of horns which must conform within given limits to known contours in flaring outwardly from throats of the horns to mouths thereof and which are provided initially with excess overall lengths embodied in extra thick throat and mouth portions of the horns, the apparatus comprising a supporting member movably disposed in the throats of the successive horns, a spider removably disposed successively in the mouths of the horns, a gage unit having a pointer normally urged below a reference position on a dial and actuable by a feeler for movement to and above the reference position, an elongate element having its ends supported respectively by the member and the spider and its intermediate portion having spaced gaging positions in a gaging area of a contour corresponding to the known contour disposed by the member and spider adjacent successive surfaces to be gaged and supporting the gage unit for sliding movement thereon whereby the feeler will move the pointer to the reference position and hold it there while the gaging unit slides from one gaging position to another through the gaging area of the element relative to a surface of the known contour and the feeler will move the pointer to positions relative to the reference position to indicate variations of a surface being gaged from the known contour, and means carried by the spider to move the element longitudinally in the horn relative to the spider and with the member until the gaging area of the element registers with a selected area of the surface to be gaged which most closely corresponds to the known contour, the supporting member having radially disposed plungers movable simultaneously to centrally locate the member in the throat and to lock it against movement when the element is located adjacent the selected area of the surface being gaged.

7. An apparatus for gaging surfaces of horns which must conform within given limits to known contours in flaring outwardly from throats of the horns to mouths thereof and which are provided initially with excess overall lengths embodied in extra thick throat and mouth portions of the horns, the apparatus comprising a supporting member movably disposed in the throats of the successive horns, a spider removably disposed successively in the mouths of the horns, a gage unit having a pointer normally urged below a reference position on a dial and actuable by a feeler for movement to and above the reference position, an elongate element having its ends supported respectively by the member and the spider and its intermediate portion having spaced gaging positions in a gaging area of a contour corresponding to the known contour disposed by the member and spider adjacent successive surfaces to be gaged and supporting the gage unit for sliding movement thereon whereby the feeler will move the pointer to the reference position and hold it there while the gaging unit slides from one gaging position to another through the gaging area of the element relative to a surface of the known contour and the feeler will move the pointer to positions relative to the reference position to indicate variations of a surface being gaged from the known contour, the element having spaced recesses therein for the gaging positions, and a resilient latch on the gage unit movable successively into and out of the recesses to locate the gaging unit in the gaging positions.

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