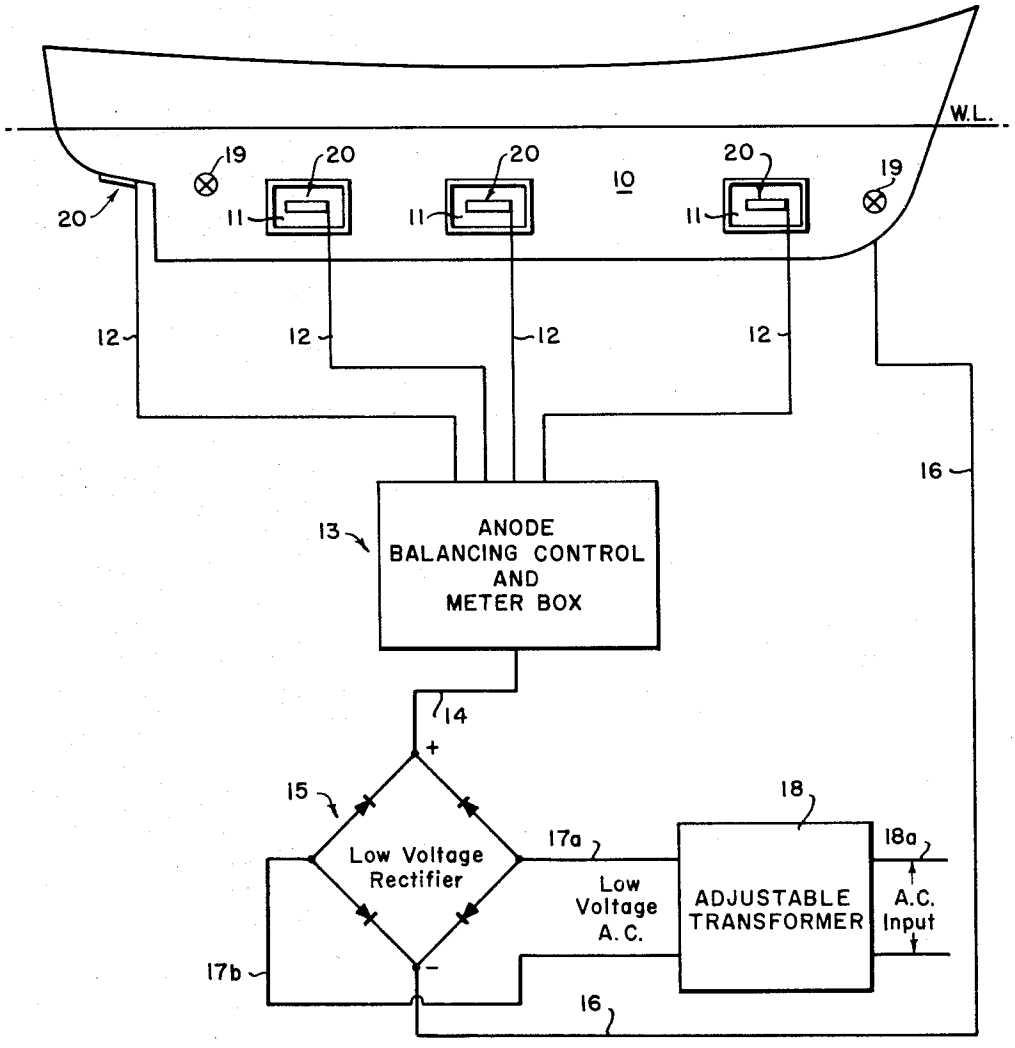
Aug. 1, 1961 H. S. PREISER ET AL 2,994,658

ENERGIZED ANODE ASSEMBLY

Original Filed Dec. 28, 1956 3 Sheets-Sheet 1

FIG. 1.



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ENERGIZED ANODE ASSEMBLY

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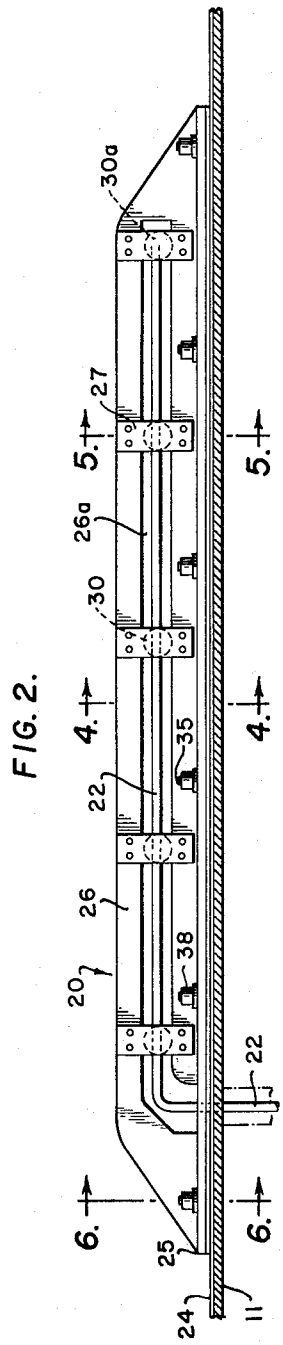


FIG. 2.

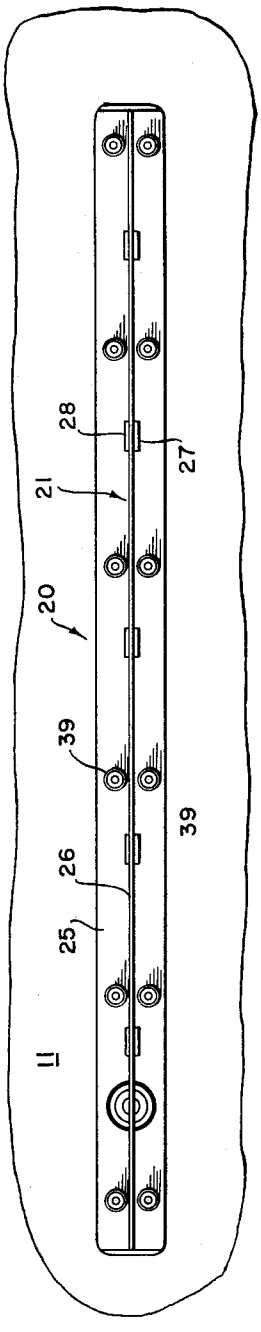


FIG. 3.

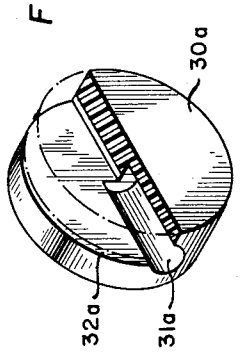


FIG. 9.

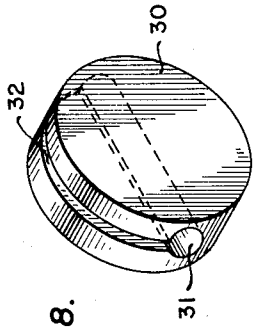


FIG. 8.

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ENERGIZED ANODE ASSEMBLY

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FIG. 4.

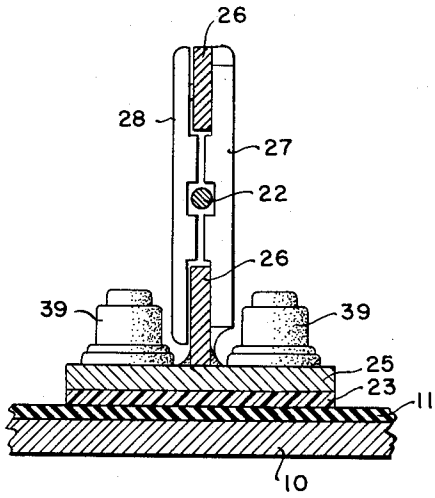


FIG. 5.

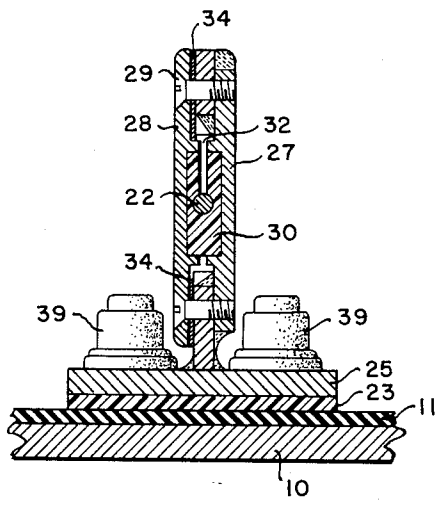


FIG. 6.

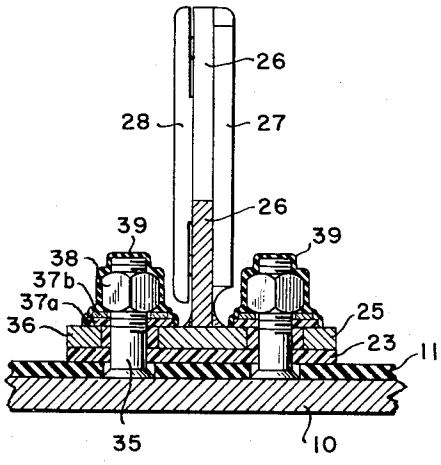
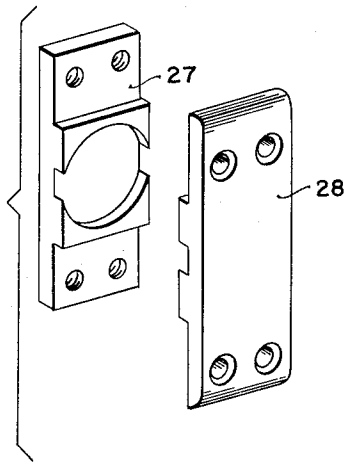


FIG. 7.



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2,994,658
ENERGIZED ANODE ASSEMBLY

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Original application Dec. 28, 1956, Ser. No. 631,377, now Patent No. 2,910,419, dated Oct. 27, 1959. Divided and this application May 29, 1959, Ser. No. 817,008

6 Claims. (Cl. 204—196)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States for governmental purposes without the payment of any royalties thereon or therefor.

This application is a division of applicants' copending application Serial No. 631,377, filed December 28, 1956, now Patent No. 2,910,419, October 27, 1959, for Energized Anode Holder Assembly.

This invention relates to cathodic protection of metals against corrosion, and more particularly to cathodic protection of the underwater hull of a surface vessel, submarine or the like against corrosion.

Cathodic protection techniques for corrosion control of marine structures are gradually finding widespread acceptance in marine and naval fields. Briefly stated, cathodic protection is the use of an impressed direct current for reducing or suppressing electrochemical corrosion of a metallic structure immersed in an electrolyte by making the structure a cathode for the impressed current. The impressed current may be supplied by sacrificial galvanic anodes or by electrically energized anodes. This invention is primarily concerned with the latter system employing inert anode materials.

For a complete disclosure of the factors responsible for the corrosion of the underwater hull of a ship or like structure reference may be had to applicants' above copending application Serial No. 631,377, now Patent No. 2,910,419, October 27, 1959.

From an examination of the factors responsible for the corrosion of the underwater hull of a ship, applicants concluded that specific materials are needed for use in cathodic protection systems. The particular properties sought will depend on the end use of the material. In general, materials are needed which are nonconducting, alkali resistant, oxy-chloride resistant, have low permeability to water transmission under a potential gradient, low water absorptivity, are nonreactive to sea water, have high strength, are impact resistant and are readily formed into a variety of shapes. Plastic materials because of their versatility lend themselves admirably for components of cathodic protection systems. The instant application is concerned with the utilization of plastics, ceramics and other acid and alkali resistant, dielectric materials.

Briefly, the elements of a cathodic protection system consist of an anode; a cathode; a current source and external circuit; and measuring instruments.

The anode for impressed current systems may be a platinum-clad silver or copper rod, or an integral platinum or platinum-clad disc or gauze, a graphite rod or slab, or other shapes of inert materials such as lead, and lead-alloys and high silicon iron alloys. The anode must be mounted in suitable holders which must be dielectric, oxy-chloride resistant, and rugged.

The cathode of a cathodic protection system is the structure under consideration; in the instant case a ship's hull. In order to insure adequate current distribution from the anode, shield materials are mounted on the hull in the vicinity of the anode. These materials must adhere to steel, have low permeability to electro-osmosis, have alkali resistance, be tough and flexible, and have good dielectric properties.

The current source and external circuit implies the use of chemically resistant cable sheaths and suitable cable attachment to the anode with appropiate seals.

The measuring instrument used for determining the cathodic potential of the structure is the reference electrode. This sensitive element must be housed in a dielectric, nonreactive, streamlined casing which is fitted with suitable cable seals.

The instant invention is particularly concerned with holders for attaching and supporting rod-type, rectifier energized anodes on the hull of a ship; surface or submarine.

An object of this invention is to provide an improved anode holder for use in cathodic protection systems.

Another object of the invention is to provide a streamlined anode holder.

Another object of the invention is to provide an anode holder that is dielectric.

Another object of the invention is to provide an anode holder that is resistant to alkali reactions.

Another object of the invention is to provide an anode holder that is resistant to oxy-chloride reactions.

Another object of the invention is to provide an anode holder that is light in weight, low in cost and high in mechanical strength.

Another object of the invention is to provide an anode holder wherein all mounting hardware is insulated and isolated.

A further object of the invention is to provide an anode holder which assists in the distribution of current from the anode.

A further object of the invention is to provide an anode holder which provides relatively free and rapid circulation of an electrolyte between the anode and a cathode.

In the instant embodiment of the invention, the holder for a platinum-clad, rod anode is constructed of steel with a ceramic coating, such as porcelain enamel, on all exposed surfaces and wherein the anode is supported in the holder by a plurality of tetrafluoroethylene, "Teflon," discs.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the several views thereof, and wherein:

FIG. 1 shows a schematic wiring diagram for an impressed current cathodic protection system in accordance with this invention;

FIG. 2 is a side elevation of a holder for a platinum-clad rod anode in accordance with the instant invention;

FIG. 3 is a top plan view of the holder shown in FIG. 2;

FIGS. 4, 5 and 6 are enlarged transverse sections taken on lines 4—4, 5—5 and 6—6, respectively, of FIG. 2;

FIG. 7 is an enlarged exploded perspective of a clamp shown in FIGS.2–6;

FIG. 8 is an enlarged perspective of one of a plurality of anode-supporting discs shown in broken lines in FIG. 2; and

FIG. 9 is an enlarged perspective, partly in section, of a disc for supporting the extreme right hand end of the anode as viewed in FIG. 2.

Referring first to FIG. 1, which illustrates a cathodic protection system wherein an impressed current is supplied by rectifier energized anodes, the numeral **10** designates the hull of a surface ship protected by a plurality of anodes **20** spaced around the sides and stern thereof. As pointed out in detail hereinafter, each of the anodes is shielded from the hull by a dielectric shield or blanket **11**. Each of the anodes is connected by a conductor **12** to an

anode balancing control and meter box **13**, which purpose is for measuring current output of each anode and for balancing differences in line resistance. Control **13** is connected by a conductor **14** to the positive side of a low voltage rectifier **15**, while the negative side of the rectifier is grounded to the hull of the vessel by a conductor **16**, thereby making the hull the cathode of the low voltage circuit. A pair of conductors **17***a* and **17***b* connect opposite sides of the rectifier to the low voltage A.C. output of electrical energy from an adjustable transformer **18** which is fed by an A.C. input **18***a*. Reference electrodes **19** are suitably mounted on the hull at least twenty-five feet from the nearest anode and are connected to a suitable potentiometer, not shown, for determining the polarization of the hull. Based on readings taken by the reference electrodes, adjustment can be made in the transformer **18** to change the current output to the anodes to correspond to the proper value. Reference electrodes (Ag-AgCl) readings below —.80 volt require an increase in the anode current, and readings above —.80 volt require a decrease in the anode current. The electric circuits, illustrated in FIG. 1, are not per se a part of this invention and therefore need not be described in further detail. It being sufficient to state that by these circuits a controlled low voltage current flows from the rectifier to the several anodes and from these through the sea water to the hull and back to the rectifier.

Referring now to FIGS. 2–6, in accordance with the instant invention, the anode assembly, indicated generally by reference numeral **20**, includes a holder **21** for supporting an inert, rod anode **22**. The holder is formed as a built-up, inverted T-shaped assembly of open hearth iron plates covered with a ceramic coating, such as, an acid resistant, dielectric porcelain enamel. The holder **21** can also be constructed from an integral rolled T-bar metal section or a built-up plastic section. The anode is formed of a platinum-clad silver rod. Between the base of the holder and the hull **10** of the vessel is a thick rubber pad **23** (FIGS. 4–6) and the dielectric shield **11**. The rubber pad, which is of substantially the same horizontal contour as the base of the holder, insures proper fit of the holder over minor irregularities in the hull and it provides a measure of shock and vibration protection to the holder. The dielectric shield is formed of sheet neoprene and it stabilizes and extends the current paths.

In practicing the invention, with an anode assembly measuring 1′ x 5′, a neoprene dielectric shield measuring 6′ x 10′ x ⅛″ thick gives excellent results in forcing anode currents out from the anode into surrounding sea water where resistance paths are more nearly uniform, resulting in substantially uniform distribution of anode currents over the hull of the vessel. This effectively reduces high current concentration near the anode with its deleterious effects on existing paint coatings. In practice, the effectiveness of the shield may be enhanced by applying a heavy coat of vinyl paint 2 to 3 feet out from the edges of the neoprene sheet. The manner of attaching the shield to the hull is described in detail in applicants' parent application, Serial No. 631,377, referred to hereinbefore.

With reference to FIGS. 4–6, the holder **21** includes a base plate **25** to which is welded an upright plate **26**. A plurality of clamp plates **27** are spaced along the upright plate (FIG. 2) and welded thereto, as shown in FIG. 5. A plurality of companion clamp plates **28** are attached to respective clamp plates **27** by screws **29**. So that the heads of the screws are flush with the outer vertical surface of plates **28**, these plates are counlersunk to receive the heads of the screws, while the shank of the screws pass through holes in the upright plate **26** and are screw threaded into tapped holes in clamp plates **27**.

Each of the clamp plates of the two sets is provided with offset portions so as to fit upon the upright plate and with a circular recess to receive and clamp therebetween an anode-holding disc **30**. The discs **30** are formed of insulating plastic, such as Teflon, with right hand end disc **30***a* (FIG. 2) formed as shown in FIG. 9, with a radial bore or well **31***a* extending part way thereinto to receive the right hand end of the rod anode, and with a saw cut **32***a* extending into the disc from the upper outer surface thereof to the longitudinal axis of the well. Each of the discs **30** is formed as shown in FIG. 8 with a diametric bore **31** extending therethrough and with a saw cut **32** extending through one half of the disc to meet the bore **31**. As shown in FIG. 2, the upright plate **26** of the holder **21** is formed with an elongated slot or opening **26***a* for the reception of the rod anode **22** and its supporting discs **30** and **30***a*. The slot **26***a* is closed at the right end (FIG. 2) of the holder, and at its left end, the slot extends downward for passage of the anode through the hull of the vessel for connection with a low voltage source of current, such as shown in FIG. 1.

In fabricating the inverted T-shaped holder, the upright plate **26**, with the slot **26***a* formed therein and with the ends beveled for streamlining as shown in FIG. 2, is welded along its length to the base plate **25**, then the clamp plates **27** are welded to the upright plate. The welds are then ground smooth in the manner shown in FIG. 5, and the sub-assembly of base plate, upright and the one set of clamp plates is coated first with a ground coat of porcelain enamel and then with a second or finish coat of acid resistant, electrical insulating porcelain enamel and then with a second or finish coat of acid resistant, electrical insulating porcelain enamel. The companion clamp plates **28** are likewise coated with two coats of porcelain enamel. Then with the discs **30** and **30***a* positioned on the rod anode, the anode is located in the slot **26***a*, the discs are located within the recesses of the clamp members and the screws **29** are applied to the clamp members. Prior to the application of the screws to the clamp members, a pair of plastic Teflon sealing gaskets **34** is located between the mating surfaces of each of the clamps **28** with the upright plate **26** as shown in FIG. 5. After the gaskets are in place and the screws tightened, the exposed ends of the screws are covered with a plastic coating of waterproof, dielectric material. The anode assembly is now ready to be attached to the hull of the vessel.

The anode assembly is attached to the hull by a plurality of corrosion resistant studs **35** (FIG. 6) welded in predetermined spaced relation along the hull. As shown in FIG. 6, the base plate **25** of the holder assembly is formed with a plurality of openings, spaced in accordance with the spacing of the studs **35**. With the base plate positioned on the studs, a ferrule **36**, formed of epoxy glass laminate or other suitable plastic, is fitted between the stud and the base plate, afterwhich a plastic washer **37***a*, a standard metal washer **37***b* and a stop nut **38** are each applied to each of the studs. After the stop nuts have been properly tightened, the fastening assemblies are each capped with a plastic bonnet **39**, which bonnet is cemented to the assembly by a waterproof dielectric adhesive. For clarity of illustration, the bonnets have been omitted in FIG. 2. Thus, the entire anode assembly with the exception of the platinum-clad anode, is waterproofed, is electrically shielded and insulated from the hull and ambient sea water, and the platinum-clad anode is electrically insulated from the entire holder and electrically shielded from the immediately surrounding hull, with low voltage currents passing only from the platinum-clad anode through ambient sea water to the hull beyond the confines of the dielectric shield **11**.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention and, although the invention has been illustrated and described in connection with particular details of construction and the particular materials specific to the instant embodiment of the invention, the details of construction and the particular materials may be modified and/or interchanged without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. An anode assembly for use in impressed current cathodic protection systems for under water protection of the hulls of ships and the like comprising, an inert anode, said anode being formed of a platinum-clad rod, a holder for the anode, said holder being formed of dielectric, anticorrosive, chemically resistant material, said holder being substantially in the shape of an inverted T and having a base portion thereof for attachment to the hull and an upright portion for mounting the anode in spaced relation to the hull, means for insulatedly mounting the base portion of the holder on the hull, and dielectric, anticorrosive, chemically resistant means for mounting the anode on the upright portion of the holder in spaced relation to the hull.

2. An anode assembly as set forth in claim 1 wherein the dielectric, anticorrosive and chemically resistant material of the anode holder comprises a ceramic coating.

3. An anode assembly as set forth in claim 1 wherein the anode holder comprises a porcelain enameled member and wherein the means for mounting the anode on the holder includes a plurality of plastic resin discs spaced along the length of the holder and having openings therein for receiving the anode rod and means on the holder for clamping the discs to the upright portion of the holder and for clamping the discs to the anode rod.

4. An anode assembly for use in impressed current cathodic protection systems for under water protection of the hulls of ships and the like comprising, an inert anode, said anode being formed of a platinum-clad rod, a holder for the anode, said holder being formed of dielectric, anticorrosive, chemically resistant material, said holder

being substantially in the shape of an inverted T and having a base portion thereof for attachment to the hull, and an upright portion for mounting the anode in spaced relation to the hull, said upright portion having an elongated slot formed therein, said anode being mounted within said slot and extending therealong; dielectric, anticorrosive, chemically resistant means for mounting the anode within the elongated slot in the upright portion of the holder in spaced relation with the hull, and means for insulatedly mounting the base portion of the holder on the hull.

5. An anode assembly as set forth in claim 4 wherein the dielectric, anticorrosive, and chemically resistant material of the holder comprises a ceramic coating.

6. An anode assembly as set forth in claim 4 wherein the anode holder comprises a porcelain enameled member and wherein the means for mounting the anode within the slot in said holder includes a plurality of plastic resin discs spaced along the length of the upright portion of the holder and having openings therein for receiving the anode rod, and means on the holder for clamping the discs to the upright portion of the holder and for clamping the discs to the anode rod.

References Cited in the file of this patent

UNITED STATES PATENTS

2,863,819	Preiser	Dec. 9, 1958
2,878,173	Obermann	Mar. 17, 1959

FOREIGN PATENTS

614,799	Great Britain	Dec. 22, 1948