

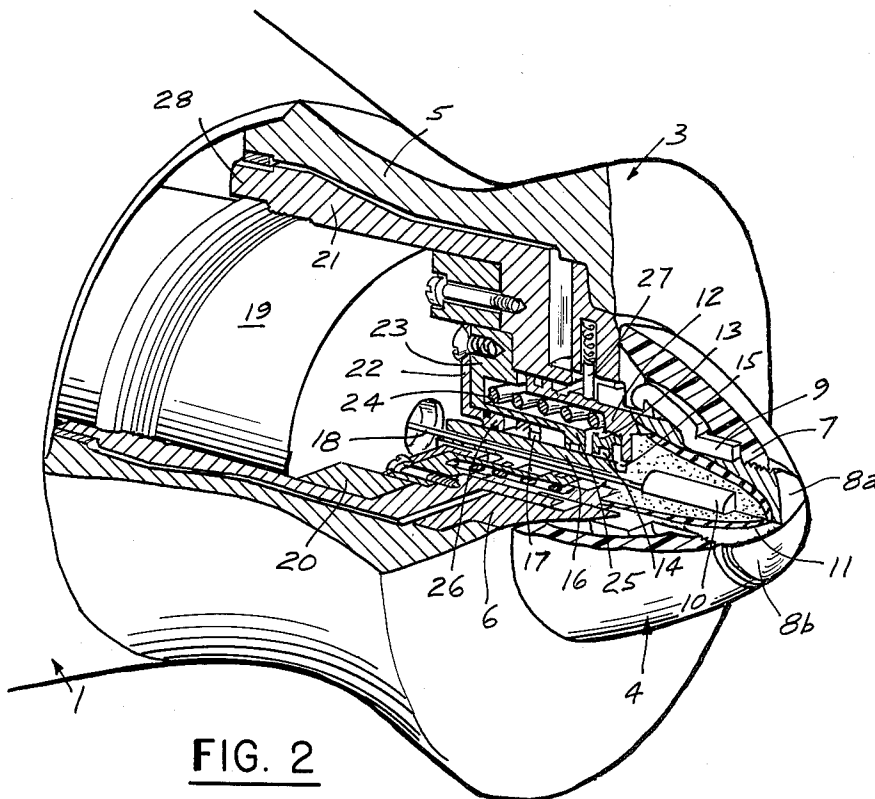
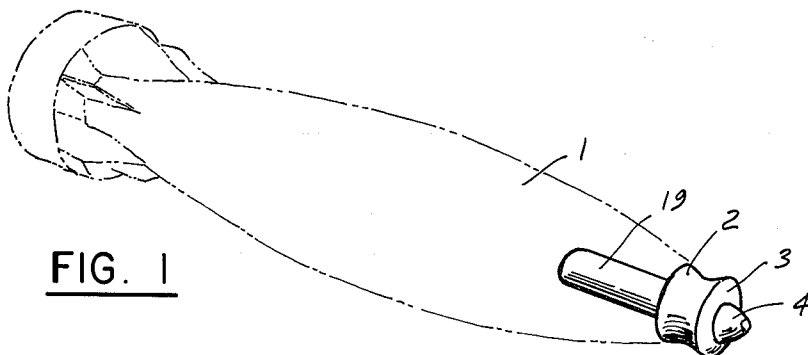
Sept. 14, 1965

L. E. GUSTAFSSON ET AL
PROTECTIVE CAP ARRANGED ON MOVABLE
OBJECTS, SUCH AS E.G. PROJECTILES

3,205,822

Filed Oct. 29, 1963

3 Sheets-Sheet 1



INVENTORS
LARS ERIK GUSTAFSSON
GÖSTA VALDEMAR WILHELMSSON
BY

Hane and Nyquist

ATTORNEYS

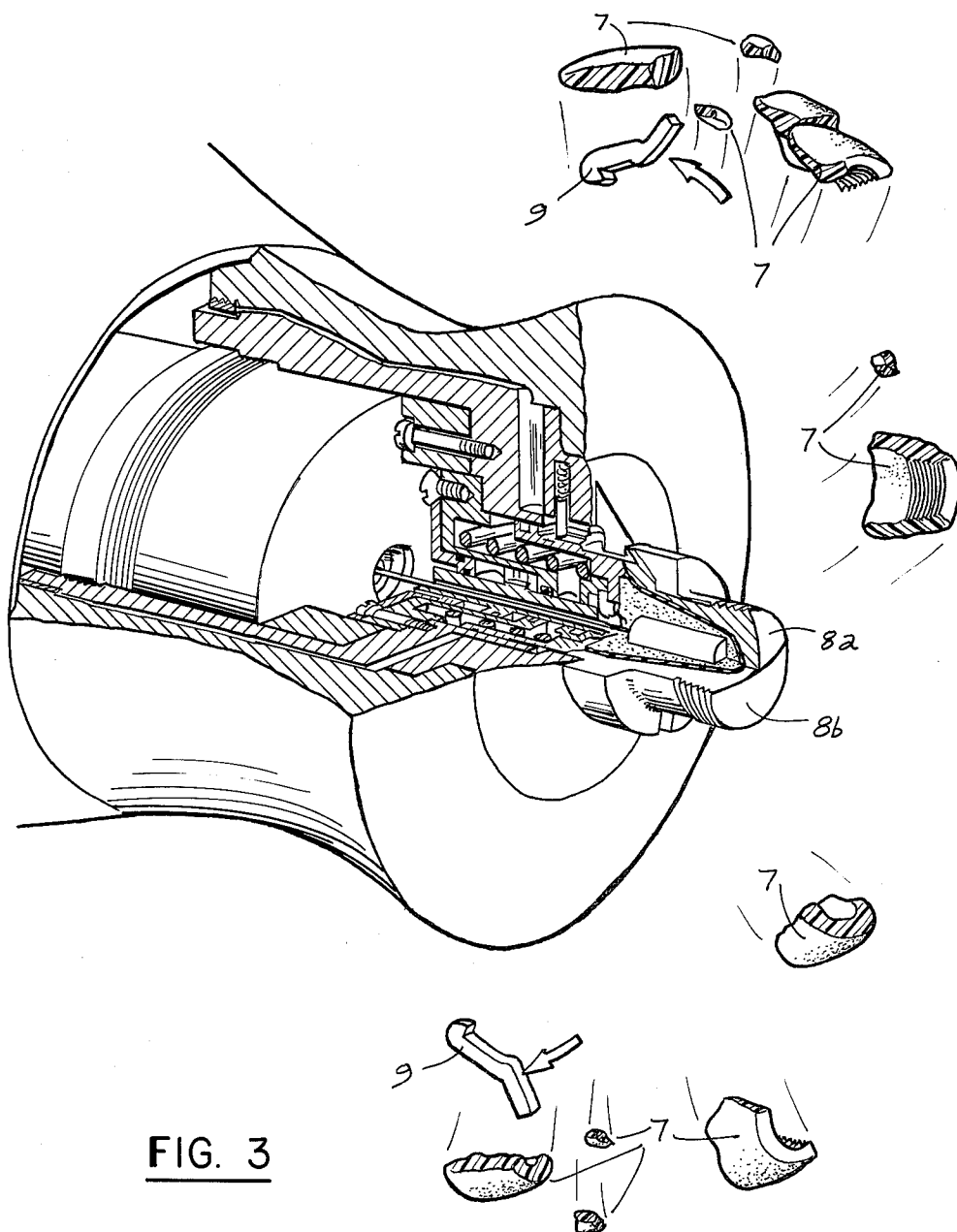
Sept. 14, 1965

L. E. GUSTAFSSON ET AL
PROTECTIVE CAP ARRANGED ON MOVABLE
OBJECTS, SUCH AS E.G. PROJECTILES

3,205,822

Filed Oct. 29, 1963

3 Sheets-Sheet 2



INVENTORS
LARS ERIK GUSTAFSSON
GÖSTA VALDEMAR WILHELMSSON
BY

Hane and Nydick

ATTORNEYS

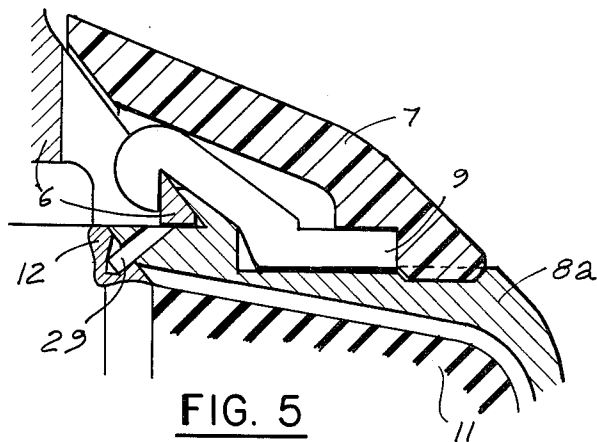
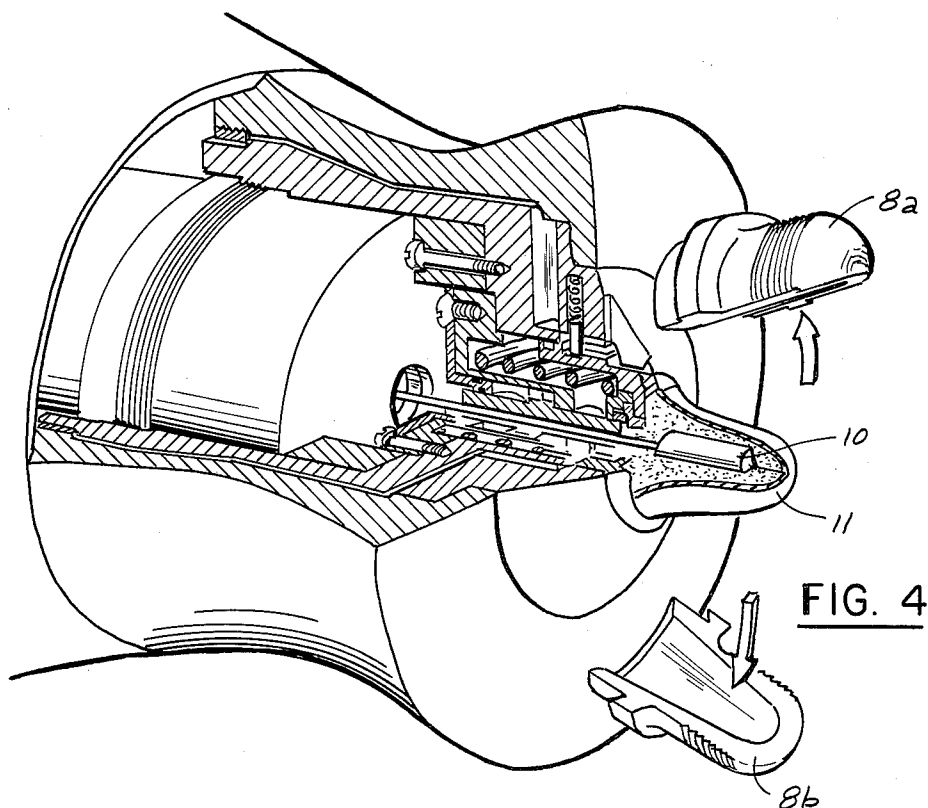
Sept. 14, 1965

L. E. GUSTAFSSON ET AL
PROTECTIVE CAP ARRANGED ON MOVABLE
OBJECTS, SUCH AS E.G. PROJECTILES

3,205,822

Filed Oct. 29, 1963

3 Sheets-Sheet 3



INVENTORS
LARS ERIK GUSTAFSSON
GÖSTA VALDEMAR WILHELMSSON
BY
Home and Nydink
ATTORNEYS

1

3,205,822

PROTECTIVE CAP ARRANGED ON MOVABLE OBJECTS, SUCH AS E.G. PROJECTILES**Lars Erik Gustafsson and Gösta Valdemar Wilhelmsson,**
Karlskoga, Sweden, assignors to Aktiebolaget Bofors,
Bofors, Sweden, a Swedish company

Filed Oct. 29, 1963, Ser. No. 319,813

Claims priority, application Sweden, Nov. 12, 1962,

12,092/62

9 Claims. (Cl. 102—54)

The present invention relates to a protective cap arranged on movable objects, such as e.g. projectiles, and more particularly to a protective cap of the type which is intended to be separated from said movable object after it has entered into a medium with greater density.

It is sometimes desirable that movable objects, such as e.g. projectiles, under part of their trajectory, are provided with a protective cap which later on, e.g. after the impact of the movable object against a medium with greater density, is detached. One such case is e.g. anti-submarine rockets, which are provided with fuzes, especially proximity fuzes. On such an anti-submarine rocket, it is necessary that the proximity fuze is protected primarily at the impact against the water, but also during the first part of the underwater trajectory of the rocket, until the flow conditions round the front part of the rocket have become mainly stabilized. On the other hand, during the remaining part of the underwater trajectory of the rocket, the proximity fuze should be arranged in such a way that it can transmit impulses and receive such from targets, if any, to the extent desired. In the present invention, the relevant problems have been solved in a way which will ensure extremely certain functioning.

According to the invention, a protective cap arranged on movable objects, such as e.g. projectiles, which is intended to be separated from said movable object after this has entered into a medium with greater density, is characterized in that the protective cap in question is held in place by a material which is shattered at the impact of the movable object against a medium with greater density.

The invention will now be described in more detail with reference to a design, given as an example, shown in the attached figures, relating to a proximity fuze fitted on an anti-submarine rocket. FIG. 1 shows schematically the location of the proximity fuze in relation to the rest of the rocket, while FIGS. 2, 3 and 4 show, on a larger scale, the front part of the proximity fuze in more detail and partly cut away. The last-mentioned three figures refer to different times in relation to the impact of the rocket against the medium with greater density, the water. Thus, FIG. 2 shows the proximity fuze before said impact, FIG. 3 shows the proximity fuze during the impact, and FIG. 4 shows the proximity fuze after the impact. FIG. 5, finally, shows, on an enlarged scale, a section through a part of the proximity fuze at a time corresponding to FIG. 2.

As will be noted from FIG. 1, in the design here shown, the proximity fuze 2, placed in the front part of the rocket body 1, has been given such a form that the front impact surface of the rocket partly consists of a spherical dome, called a force director 3. Through this force director 3, the rocket obtains improved stability at the impact against the water, in a way which, in itself, is known. In the middle of the force director 3, a nose 4, having the form of a rounded cone, is placed.

The details of the construction of the front part of the proximity fuze 2 are shown in FIG. 2. The ring-shaped housing 5, which forms the force director 3 described above, is connected to the rocket body 1, via threads.

2

The center of the force director 3 consists of a ring 6, and the conical nose 4 is connected to this ring 6. The outer surface of this conical nose 4 consists of a ring-shaped housing 7, which is made of such a material, e.g. appropriately brittle plastic, that it is shattered at the impact of the rocket against the water. Inside the ring-shaped housing 7, a protective cap is arranged, which through a plane through the symmetry axis of the proximity fuze is divided into two halves, 8a and 8b. The halves 8a and 8b of the protective cap are secured to the ring 6 by means of two diametrically opposite catches 9, of which, however, only one is shown in FIG. 2. The rear parts of the catches 9 are made in the form of hooks, which engage into corresponding recesses in the ring 6. In the front part, the catches 9 are provided with steps, which fit into grooves made in the halves 8a and 8b of the protective cap. The front parts of the catches 9 bear against the halves 8a and 8b of the protective cap, under the influence of the ring-shaped housing 7. In the center of the nose 4, a transducer 10, which is appropriate for proximity fuzes, is placed, which is surrounded by a pointed capsule 11, which is made of such a material, e.g. rubber of an appropriate quality, that the impulses between the transducer 10 and the surrounding water, after the halves 8a and 8b of the protective cap have been removed, can pass, unaffected to the greatest possible extent. The capsule 11 is fastened at the front, constricted end of the cylindrical sleeve 12, which, in turn, by means of the partly threaded rings 13, 14 and 15 is fixed to the hollow shaft 16. At about the middle, this shaft 16 is provided with a protruding ring-shaped step 17, and through the central hole in the shaft 16 a cable 18 is drawn from the transducer 10 in to the cylindrical container 19, which comprises the rear part of the proximity fuze (see FIG. 1) and in an entirely conventional way for proximity fuzes contains the necessary transmission, registration and releasing devices, which devices, however, are not shown in detail in the figures. A ring 20 is placed along the outer edge of the front plane surface of the cylindrical container 19. This ring 20 and the front part of the cylindrical surface of the container 19 is encompassed by the cylindrical sleeve 21, which also forms a transition between the cylindrical container 19 and the ring-shaped housing 5. The ring 20 is screwed on to the cylindrical sleeve 21, and this sleeve 21 is connected by means of threads to the cylindrical container 19. The cylindrical sleeve 21 with parts attached inside same is secured in the ring-shaped housing 5 by means of an externally threaded ring 28. The front plane surface of the cylindrical sleeve 21 is arranged at a certain distance from the rear plane surface of the ring 6, and in the cylindrical chamber formed in this way, a number of spring packages are placed which, however, are not shown in the figures. These spring packages can, to a certain extent, absorb the axial stresses on the nose 4, e.g. at the impact of the rocket against the water and, moreover, simplify the fitting of the proximity fuze, so that a good transition can be obtained between the surfaces which are directed forwards of the ring-shaped housing 5 and the ring 6.

Inside the ring 20 and the sleeve 21, the cylindrical elements 22 and 23 are arranged, which have steps 26 and 25 at their front parts, which are formed as sealing members. The element 23 is screwed to the cylindrical sleeve 21, and the element 22, in turn, is screwed to the element 23, and the steps 26 and 25 will then be on opposite sides of the step 17 on the shaft 16.

The unit composed of the parts 10-16 is movable in an axial direction, and then primarily in relation to the parts 21, 22 and 23. The helical spring 24, which is placed between the parts 12 and 23, strives to achieve such an axial movement forwards, but this movement is prevented, as long as the ring-shaped housing 7 is intact,

3

by the halves 8a and 8b of the protective cap, which are held in place by means of the catches 9.

The ring-shaped steps 25 and 26 placed on opposite sides of the step 17, are in contact with the outer surface of the shaft 16. The step 17 bears against the part of the cylindrical inner surface of the element 23 between the steps 25 and 26. All three steps 17, 25 and 26 are sealed against the corresponding cylindrical bearing surfaces with the aid of O-rings. The chambers between the steps 26, 17 and 25 are filled with oil, and as the step 17 is provided with a narrow channel, the device, in a way which in itself is known, will function as a delayed-action device when the unit composed of the parts 10-16 are displaced axially. Through the spring-loaded pin 27, placed in the ring 6, this unit can be blocked in its forwards position.

As shown by FIG. 5, the halves 8a-8b of the protective cap, the ring 6 and the sleeve 12 are joined together in a special way. The foremost part of the ring 6 has a pointed edge, formed by a cylindrical and a conical surface. A groove corresponding to this edge has been made in the rear parts of the halves 8a-8b of the protective cap. Furthermore, at the rear, these halves are each provided with a pair of pins 29, which are parallel in relation to each other and are directed obliquely rearwards. In the conical surface of the ring 12 which is directed forwards, there are two pairs of holes, which correspond to the pins 29. These holes have been cut up in a direction which is nearly at right angles to the symmetry axis of the proximity fuze, whereby the pins 29 do not prevent the front ends of the halves of the protective cap from being separated. Through the above-mentioned arrangement, the halves of the protective cap cannot be released until the surface of the sleeve 12 which is directed forwards has come mainly in line with the conical surface of the ring 6 which is directed forwards.

The invention functions in the following way:

At the impact against the water, the ring-shaped housing 7 will be shattered (see FIG. 3), whereby the front ends of the catches 9 will no longer bear against the halves 8a and 8b of the protective cap, and these catches 9 will be released from the rocket. When the catches 9 have been released, they will no longer prevent the forwards movement in an axial direction which the spring 24 strives to achieve of the unit composed of the parts 10-16. This axial, forwards movement of the unit 10-16 will, however, be prevented by the pressure of the water against the halves 8a-8b of the protective cap. It is only when the water pressure acting against the halves 8a-8b of the protective cap has diminished, and the flow conditions around the front part of the rocket have become mainly stabilized, that the spring 24 will be capable of moving the unit 10-16 to its foremost position. In this foremost position, the conical surface of the sleeve 12 which is directed forwards will be in line with the conical surface of the ring 6 which is directed forwards, and the two halves 8a-8b of the protective cap will thus be released (see FIG. 4). The unit 10-16 is retained in its forwards position by the pin 27, so that the static pressure, which increases as the water depth becomes greater, is not capable of pressing back the unit 10-16.

If the rocket enters the water with a small angle of impact, the ring-shaped housing 7 will be shattered before the halves 8a and 8b of the protective cap have come below the water surface. Because of the delayed-action device composed of the elements 22-26, 16-17 and 23-25, however, the moving forwards of the unit 10-16 will be delayed so long that there will be time for the water pressure to build up against the halves 8a and 8b of the protective cap before these are released.

After having been protected by the halves 8a and 8b of the protective cap during and immediately after the impact against the water, the transducer 10 will now, during the remainder of the underwater trajectory, only

4

be surrounded by the capsule 11, and will in that way be capable of transmitting and receiving impulses to and from the surroundings, comparatively unobstructed.

The invention is not in any way limited to the design described above but can, of course, be varied within the scope of the concept of the invention.

We claim:

1. A protective device for a missile including a sensing means and having an operational trajectory during which the missile passes from a low density medium into a medium of high density, said protective device comprising a protective cap loosely supported on said missile in a position protecting said sensing means, and cap control means mounted on the missile in a position retaining said cap in its protective position and made of a fragile material arranged to be fractured upon passage of the missile from the low density medium into the high density medium, fracturing of said control means freeing said cap for removal from its position by the force of the high density medium now acting upon the cap.

2. A protective device for a missile including a sensing means and having an operational trajectory during which the missile passes from a low density medium into a medium of high density, said protective device comprising a protective cap loosely supported on said missile in a position protecting said sensing means, cap release means mounted on the missile and coacting with the cap to urge the latter out of its protective position, and cap control means mounted on the missile and coacting with said release means to hold the same inoperative for moving the cap out of its protective position, said control means being made of a fragile material arranged to be fractured upon passage of the missile from the low density medium into the high density medium, fracturing of the control means freeing said release means for removal of the cap from its protective position.

3. A protective device according to claim 2 and further comprising delay means also coacting with said release means to delay action thereof for the purpose aforesaid, said delay means being mounted on the missile in a position initially protected by said fragile cap control means and upon fracturing of the control means being exposed to the force of the high density medium, the delay time of said delay means being controlled by said force decreasing below a predetermined value, the magnitude of the force being a function of the velocity of the missile within the high density medium.

4. A protective device according to claim 2, wherein said cap is displaceably mounted, and releasable clamping means retain said cap in said protective position, said fragile control means retaining the clamping means in the clamping position, and wherein said release means comprise an actuating means displaceably mounted on the missile and engageable with said cap and spring means also mounted on the missile and engaging said actuating means to displace the same and said cap, said displacement of the cap releasing said clamping means.

5. A protective device according to claim 4, wherein said cap is disposed in a position in which it is exposed to the force of the high density medium upon fracturing of said fragile control means, the magnitude of said force being determined by the velocity of the missile in said high density medium and counteracting said spring means until the force decreases below a predetermined value, thereby correspondingly delaying the release of the cap.

6. A protective device according to claim 4, wherein said cap comprises two complementary parts, and said clamping means retain said cap parts in a cap-forming spatial relationship with respect to each other.

7. A protective device according to claim 4, wherein locking means retain said actuating means in said displaced position.

8. A protective device according to claim 4, wherein said cap comprises two complementary parts and said

5

clamping means retain said cap parts in a cap-forming spatial relationship in reference to each other, said clamping means including two catch elements each engaging at one end one of said cap parts and terminating at the other end in a hook engaging a recess in the missile, said actuating means upon displacement thereof engaging said hooks and lifting the same out of said recesses, thereby freeing said cap parts.

9. A protective device according to claim 4, wherein said cap comprises two complementary cap parts each having a leading and a trailing end, and wherein retaining means retain the trailing end of each cap part at a predetermined distance in reference to the center axis of the missile, said retaining means being releasable by increasing said distance, said actuating means being engageable with said retaining means in a predetermined

6

position of displacement of the actuating means to increase said distance upon reaching said position of displacement of the actuating means.

References Cited by the Examiner

UNITED STATES PATENTS

2,782,716	2/57	Johnson	102—56
3,048,110	8/62	West	102—53

FOREIGN PATENTS

576,683	2/46	Great Britain.
---------	------	----------------

BENJAMIN A. BORCHELT, *Primary Examiner.*

FRED C. MATTERN, JR., *Examiner.*