Sept. 21, 1965 J. R. HOLDEN 3,207,072

WINGED SHAPED CHARGE

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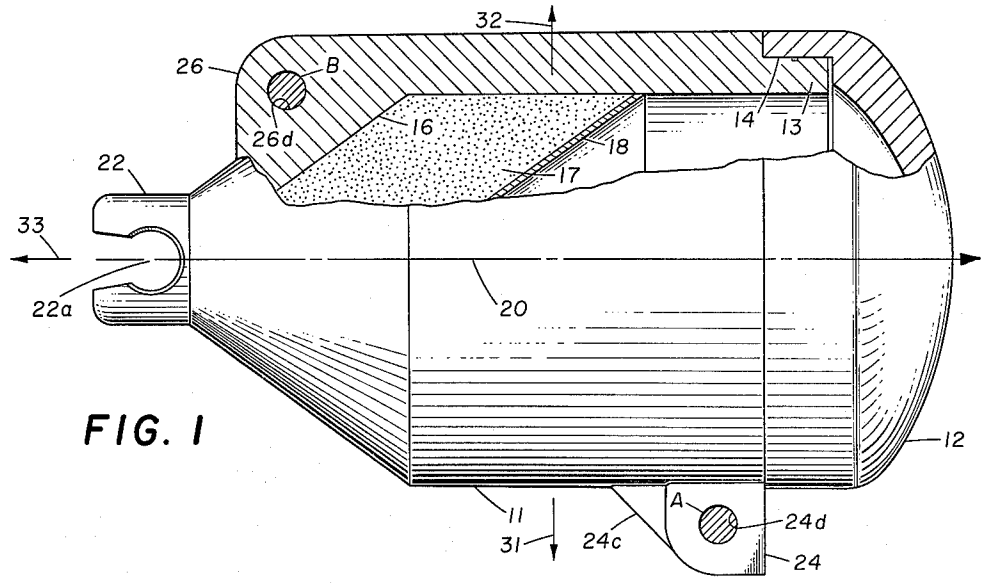



FIG. 1

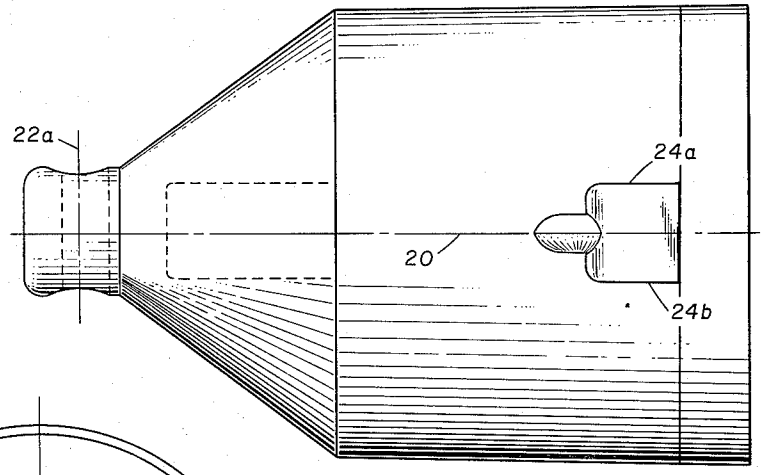
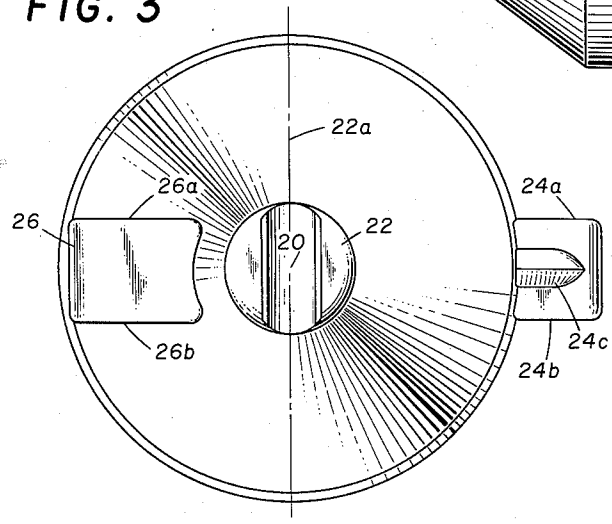



FIG. 2

FIG. 3




JAMES R. HOLDEN

INVENTOR.

BY O. Earl Richards

ATTORNEY

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FIG. 5

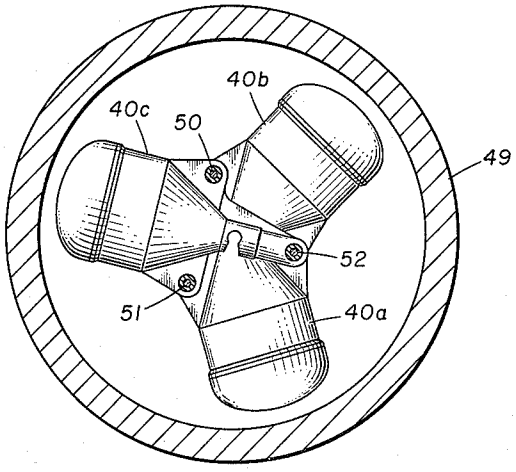
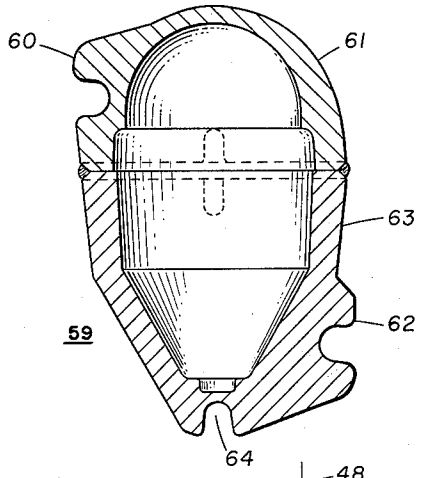



FIG. 7



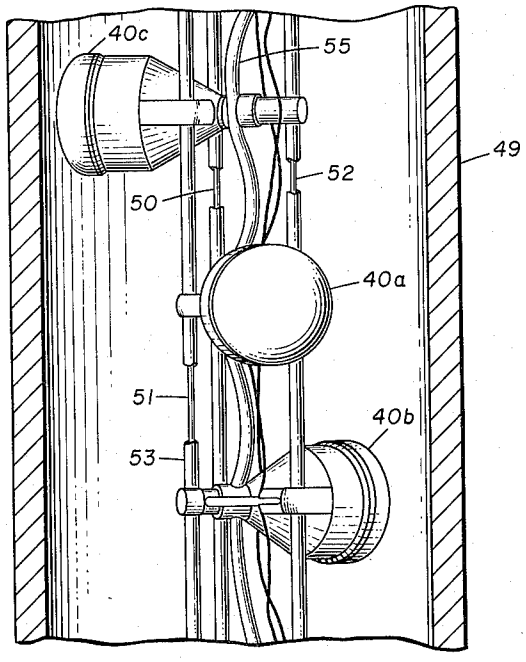
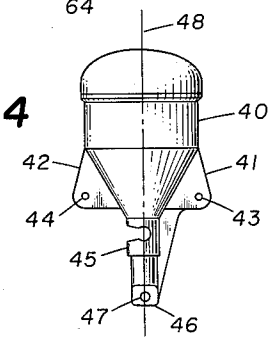




FIG. 6

FIG. 4



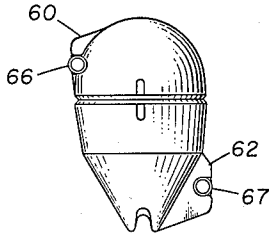




FIG. 8

JAMES R. HOLDEN

INVENTOR.

BY D. Earl Richards

ATTORNEY

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# WINGED SHAPED CHARGE

James R. Holden, Fort Worth, Tex., assignor, by mesne assignments, to Harrison Jet Guns, Ltd., Houston, Tex., a limited partnership of Texas

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6 Claims. (Cl. 102—24)

This invention relates to shaped charges for perforating oil wells and the like, and, more particularly, to a winged shaped charge suitable for mounting in an array for simulataneously perforating casing in several directions. In a further aspect, the invention relates to a multicharge array in which the shaped charges each are provided with winged structures geometrically oriented for multidirectional orientation.

Perforators are extensively employed in oil producing operations and generally are one of two types. Bullet-type gun perforators were the first to be used. More recently, shaped charges have largely supplanted bullet-type gun perforators. Shaped charges for oil well perforating have been mounted inside of hollow tubular members or guns with the axes of the charges transverse to the axis of the gun and oriented along different directions in azimuth in order to provide omnidirectional perforations in the casing wall. Further, shaped charges have been mounted on elongated straps and within elongated twisted sheets forming expendable support structures for a plurality of charges while permitting some variation in orientation other than limiting the perforations to a single plane as would be the case with shaped charges facing forwardly and rearwardly from a planar mounting strip.

The present invention is directed toward a shaped charge for mounting on an expendable support in which the charge can be securely mounted while permitting the orientation thereof in any one of a multiplicity of directions.

In accordance with the present invention, there is provided a shaped charge for utilization in an omnidirectional, expendable shaped charge array. There is provided a hollow casing of imperforate material having a generally conical hollow in one end thereof. An explosive body is disposed within the hollow with a thin rigid liner having a shape corresponding to that of the hollow and seated in the explosive body coaxially in the hollow. At least two perforated wings are provided extending from the exterior surface of the casing, preferably in a common plane passing through the axis of the casing. The wings are located on opposite sides of the axis for receiving supporting rods for the array. A slotted structure is then provided adjacent the apex of the hollow for receiving a detonator element.

In a further aspect of the invention, a shaped charge array is provided which comprises at least two elongated rods extending parallel one to the other. A plurality of shaped charges are positioned or mounted on said rods at selected points spaced along the array and facing outwardly therefrom with their axes perpendicular to the axis of the array. Each of said charges has perforated wing extensions through which the rods pass with the charges facing away from the axis in a plurality of directions. Spacer means encompass the rods and extend into abutting relation with the wing extensions to maintain the charges in predetermined spaced relation and orientation along the array. A common detonator is then threaded through the array contacting each of the charges at a detonation point for actuating the charges.

In a preferred embodiment of the invention, there is provided a shaped charge for mounting on a pair of rods to face any one of four directions. One of the winged extensions is positioned forward of the base of the conically shaped hollow and on one side thereof. The other winged extension is adjacent the apex of the conical-shaped hollow and located diametrically opposite the first wing whereby the perforations therein may be located at the corners of a rectangular configuration to permit any charge to be oriented in any one of four directions.



For a more complete understanding of the present invention and for further objects and advantages thereof, reference may now be had to the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a top view, partially in section, of one embodiment of the invention;

FIGURE 2 is a side view of the unit of FIGURE 1;

FIGURE 3 is a rear view of the unit of FIGURE 1;

FIGURE 4 is a top view of a modification of the invention for providing three-directional orientation;

FIGURE 5 is a top view looking down on an array oriented in a casing to be perforated;

FIGURE 6 is a side view of the unit of FIGURE 5 with the casing broken away;

FIGURE 7 illustrates a glass casing for a shaped charge of the present invention shown in section; and

FIGURE 8 is a top view of a completed unit formed of glass materials.

Referring now to FIGURE 1, there is illustrated a top view of a shaped charge having a casing body **11** with a cap portion **12** fitted together to form a fluidtight enclosure. The casing **11** and cap **12** are preferably of imperforate material such as zinc, glass, aluminum, iron, iron alloys, or the like. The casing is provided with a cylindrical extension **13** which seats in the annular recess **14** in the cap **12**. The closed end of the casing **11** has a conical internal wall **16** in which there is positioned an explosive body **17**. A thin-walled, rigid liner **18** of conical shape is seated in the explosive body **17** with the axis of the conical-shaped liner coinciding with the axis **20** of the casing **11**. The shaped charge is thus designed to direct a high-velocity particle stream along the axis **20** in the direction of the arrows, as is well understood in the art.

At the base of the casing **11** there is provided a slotted extension **22**. The slot is of cylindrical configuration open rearwardly of the casing to permit the insertion of a rope-like or cord-like detonator element.

The casing **11** is provided with a pair of wings **24** and **26**. The wing **24** is located adjacent the mouth of the casing **11** and, as best seen in FIGURE 2, is a substantial solid body having a planar upper surface **24***a* and a planar lower surface **24***b* with the surfaces being parallel one to the other and parallel to a plane passing through the axis **20** of the casing. The surfaces **24***a* and **24***b* preferably are perpendicular to the axis **22***a* of the slotted portion at the base of the casing **11**. The second wing **26** is formed integrally with the conically shaped rear wall of the charge and is located diametrically opposite the wing **24**. It has upper and lower planar surfaces **26***a* and **26***b* which are coplanar with surfaces **24***a* and **24***b*, respectively. The wing unit **24** is provided with a supporting fillet **24***c*. The wings **24** and **26** preferably are cast integrally with the body portion of the casing **11**. The wing **24** is provided with an aperture **24***d*. Similarly, the wing **26** is provided with an aperture **26***d*.

With the shaped charge of the type illustrated in FIGURES 1–3, it will now be apparent that supporting rods may pass through each of the apertures **24***d* and **26***d* to support a plurality of such charges in a multidirectional charge array. For convenience of reference, a rod A is shown passing through the aperture **24***d* and a rod B is shown passing through aperture **26***d*. In the position shown, the charge thus mounted would be directed to the right. If the charge is lifted off from rods A and B

and turned over, the charge would then face downward in the direction of arrow 31. The charge may be placed on rods A and B to face upwardly along the direction of arrow 32 or rearwardly along the direction of arrow 33 by fitting it onto rods A and B in the other possible positions. Thus, a pair of wings are provided for mounting the charge on two rods. One wing is on one side and forwardly of the body and the other wing is on the opposite side rearwardly of the body. By this means a given charge can be mounted to face any one of four different directions.

In FIGURE 4, there is illustrated a shaped charge 40 which, from the standpoint of internal construction and function, may be the same as that illustrated in FIGURE 1. Charge 40 is provided with a pair of wings 41 and 42 which are both formed on the rearward conical surface of the charge 40. The wing 41 is provided with an aperture 43 and the wing 42 is provided with an aperture 44. At the base of the unit 40 there is provided a slotted structure 45 having a transverse slot whose axis is parallel to the axis of the apertures 43 and 44. By this means a string detonator can be inserted for detonating the charge 40. Extending rearwardly from the slotted structure 45 is a mounting extension 46 having an aperture 47. The axis of aperture 47 is parallel to that of apertures 43 and 44 and is located in an equilateral triangular relationship with respect to the apertures 43 and 44, being positioned along the axis 48 of the unit 40.

As illustrated in FIGURE 5, the unit of FIGURE 4 can be mounted to face any one of three directions for perforating a casing such as a casing 49. The units 40*a*, 40*b* and 40*c* are mounted on three rods 50, 51 and 52. The rods support each of the units 40*a*, 40*b* and 40*c* to maintain their orientation in azimuth. The orientation as to elevation is maintained, as shown in FIGURE 6, by a plurality of spacer cylinders such as the cylinder or tube 53 which encompasses the rod 51. The spacer tubes 53 are cut to lengths equal to the desired spacing between the charges. The thickness of the wings 43, 44 and the extension 46 preferably is equal so that tubes of equal length may be employed to provide geometrically uniform array. In practice, a string of charges can be made as long as it desired to span the formation to be perforated. A detonator 55, preferably of the type known as Primacord, is threaded the length of the charge array and is wedged into the slot in each base section so that upon detonation at one end a detonation wave will travel along the Primacord, and as it passes each of the charges in succession will initiate detonation thereof adjacent to the tip of the conical-shaped explosive body in each charge. By this means an omnidirectional perforating operation can be carried out with minimal expense and with positive orientation of the various charge elements.

Referring now to FIGURE 7, there is illustrated in a sectional view a shaped charge case 59 formed from a frangible material such as glass or ceramic. The case 59 generally conforms with the embodiment of the invention illustrated in FIGURES 1–3. The case 59 is formed with a forward wing 60 on the cap 61 and a rearward wing 62 on the base 63 with slots extending therethrough perpendicular to the planar surfaces of the wings and parallel to the slot 64 at the tip of the conical-shaped interior rearwardly of the shaped charge. The cap 61 is secured to the base 62 by a ring deposit of an epoxy resin or the like. As illustrated in FIGURE 8, the wings 60 and 62 are provided with tubular inserts 66 and 67 which are secured therein as by a suitable adhesive such as an epoxy resin. The inserts 66 and 67 may be of metal and are hollow as to receive the supporting rod such as illustrated in FIGURES 5 and 6. The metal inserts would then provide support for the spacers surrounding the rods so that a frangible glass case may be employed for the shaped charge itself while permitting mounting on a rigid supporting structure. The inserts 66 and 67 of FIGURE 8 may be either tubular or spiral elements. In either case they are secured in slots in the wing portions 60 and 62, respectively. Either tubes, springs or spiral elements will facilitate connection between the skeletal rods and the wing elements on the charges. Where elements 66 and 67 are tubular, the charges will be threaded over rods such as rods 50 and 52, FIGURE 6, along with spacer tubes. Where elements 66 and 67 are spring elements or spiral elements, secured at one turn thereof to wings 60 and 62, they would receive and wrap around spacer rods to permit side loading.

While the units of FIGURES 1–6 have been illustrated and described with perforated wings through which rods are threaded for mounting, it may be found desirable to install the charges onto the rods from the side rather than thread the wings over the rods. In such case the wings 24 and 26 of FIGURE 1 would be slotted in much the same manner as the slot 22*a* in the extension 22 so that the rods could be slipped in from the side. The slots may be beveled as illustrated in the slot 22*a* of FIGURE 1 or may be more positively recessed so that the tubes, such as tube 53 in FIGURE 6, would register with the beveled or recessed portion in the wing adjacent the slot to maintain a positive position of the charge body relative to the rods. The same is true of the device of FIGURE 4 where the wings, rather than being pierced as illustrated, may be slotted. If the wings 24 and 26 of FIGURE 1 are to be slotted and then mounted on skeletal rods, the wings may be recessed from either on or both sides by removing approximately half the thickness of the wings to form reentrant portions in which the positioning cylinders or sleeves, such as sleeve 56, would seat. Spring or spiral elements may also be employed as in FIGURES 7 and 8. Thus, the present invention permits either end loading or side loading onto a skeletal array of supporting rods while facilitating orientation of the charge units for multidirectional perforation.

It will be appreciated that the foregoing is illustrative only of variations in configuration of shaped charges in which winged extensions are provided on the casing which are perforated to encompass supporting rods and to support suitable spacers placed over such rods.

Having described the invention in connection with certain specific embodiments thereof, it is to be understood that further modifications may now suggest themselves to those skilled in the art and it is intended to cover such modifications as fall within the scope of the appended claims.

What is claimed is:

1. A shaped charge for an omnidirectional expendable shaped charge array which comprises:
   (a) a hollow casing of imperforate material having a generally conical hollow in one end thereof,
   (b) an explosive body disposed within said hollow,
   (c) a thing rigid liner having a shape corresponding with said hollow and seated in said explosive body coaxially of said hollow,
   (d) at least two perforated wings extending in a common plane passing through the axis of said casing and located on opposite sides of said axis for receiving supporting rods in said array, one of said wings being forward of the base of said conically shaped hollow and on one side thereof and the other of said wings being adjacent said apex of said conically shaped hollow and diametrically opposite the first wing whereby said wings may be mounted selectively on a pair of rods to face any one of four directions, and
   (e) a slotted structure adjacent to the apex of said hollow for receiving a detonator element.

2. The combination set forth in claim 1 in which said wings are protrusions having opposing flat surfaces parallel to a plane passing through the axis of said conically shaped hollow to provide support for charge spacer means.

3. The combination set forth in claim 1 in which said wings have flat surfaces parallel one to the other and to

a plane coinciding with the axis of said conically shaped hollow with holes passing through each said wing at an intermediate point thereon.

4. The combination set forth in claim 1 in which said wings have flat surfaces parallel to a plane coinciding with the axis of said conically shaped hollow and are slotted in directions perpendicular to said axis and to said planes with short tubular means secured in the slotted portions for encompassing supporting rod structures.

5. The combination set forth in claim 1 in which said wings extend parallel to a plane coinciding with the axis of said conically shaped hollow and are slotted in directions perpendicular to said axis and to said plane with means



secured in each of the slotted portions for encompassing and securing the charge to supporting rod structures.

6. The combination set forth in claim 5 in which spring elements are secured in each slot for securing the charge to a supporting rod array.

**References Cited by the Examiner**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,629,325 | 2/53 | Sweetman | 102—20 |
| 2,733,657 | 2/56 | Bryant et al. | 102—20 |
| 2,947,252 | 8/60 | Lindsay | 102—20 |

SAMUEL FEINBERG, *Primary Examiner.*