July 23, 1968 M. C. GASKIEVICZ ET AL 3,394,339

CONNECTOR

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Fig. 1.

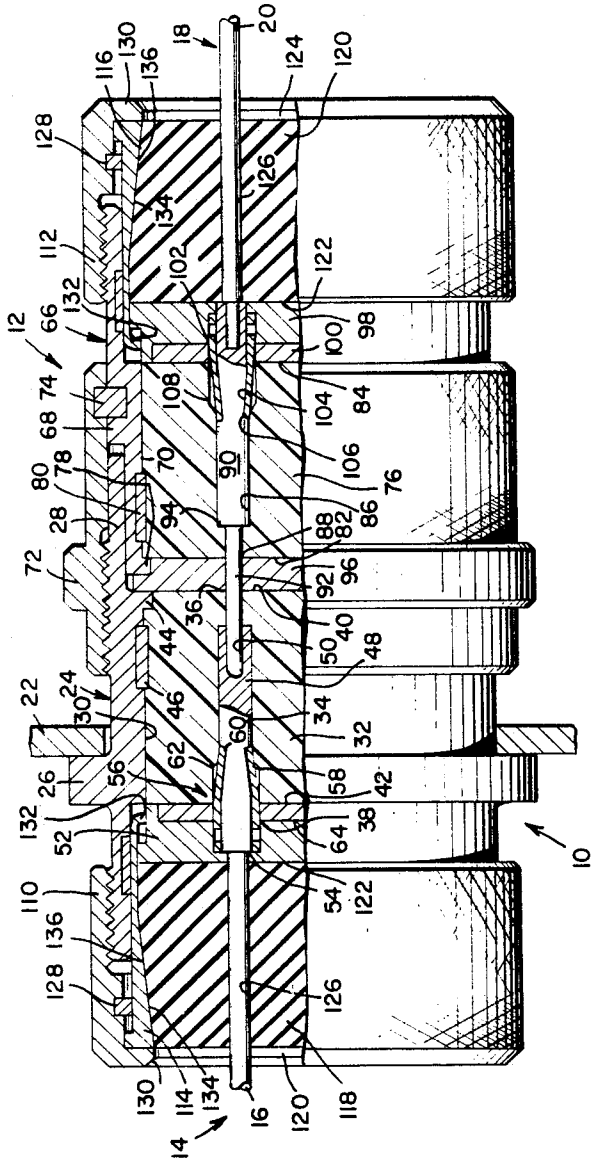


Fig. 2.

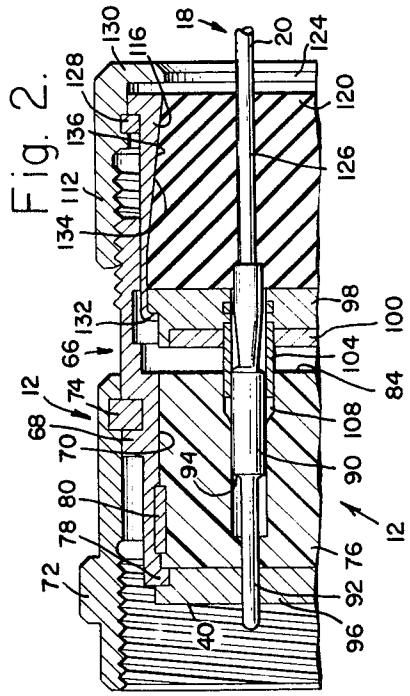
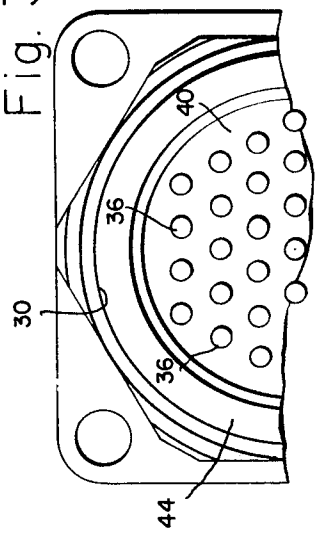


Fig. 3.



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CONNECTOR

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ABSTRACT OF THE DISCLOSURE

The present invention relates to electrical connectors for individually interconnecting a large number of electrical conductors in a first cable with respective conductors in a second cable. In connectors of this variety a first or plug portion of the connector mates with a second or socket portion of the connector. Each portion of the connector includes a large number of contacts attached to the ends of the conductors and sealed in the plug or socket. These contacts are positioned to engage a complementary contact on the other portion of the connector when the two portions are mated. One area of improvement over the prior art is the means by which the individual contacts in either the plug or socket portions or both may be removed from the connector and/or replaced without any special tools, disassembling the connector, etc. This connector thereby makes it possible to very quickly and simply repair the connector or interconnect equipment.

It is frequently desirable to quickly and easily interconnect and/or disconnect the individual conductors in a large set (for example in a cable) with the individual conductors in another large set (for example in a second cable). One means of accomplishing this is to provide a pair of mating connectors having pluralities of electrical contacts therein. The contacts in the two connectors are permanently attached to their respective conductors whereby mating the connectors completes the electrical circuits.

Most installations require that the connectors be sealed against moisture, etc., to protect the various portions of the connector. This is normally accomplished by providing one or more insulating and/or sealing members in the connector for supporting the various contacts and conductors in position. The sealing members tightly engage the interior of the connector and the exteriors of the conductors, contact, etc., and thereby form moisture proof barriers. In order to maintain the contacts and conductors properly positioned in the insulating and sealing members, a detent is provided for each contact. When the contact is forced into the insulating member the detent snaps into the locked position whereby the contact cannot be pulled out of the connector. Such connectors have been very successful for interconneting a large number of individual conductors together. However, under some circumstances it may become necessary to replace one or more of the conductors as a result of damage thereto and/or a change in the wiring.

Heretofore this has been accomplished by employing a special removal tool for releasing the detent. The tool is designed to slide along the side of the conductor and/or contact until it engages and releases the detent. In order to insure an effective sealing action and/or to insure a precise alignment of the contacts, it is essential that the clearance space between the conductor or contacts and the sealing or insulating members be as small as possible. This in turn requires that the removal tool be very thin. As a result of being very thin, the tool is fairly sharp and the insulating and sealing members are frequently cut or damaged. To avoid such damage it is necessary for the operator to be very careful. As a consequence the changing of the contacts is very time consuming and requires a certain amount of skill. It will thus be seen that the foregoing connectors have not been entirely satisfactory for all applications.

The present invention provides means for overcoming the foregoing difficulties. More particularly the present invention provides a connector wherein the various contacts and/or conductors may be readily replaced in a very short time without in any way damaging any portion of the connector. This is accomplished by providing means for removing and replacing the contacts and conductors without the necessity of employing any special tools.

In the single embodiment of the present invention disclosed herein, the individual contacts are crimped to the ends of their respective conductors and then manually forced into passages extending through a resilient sealing member and an insulating member. After all of the contacts are in position, means simultaneously compress a sealing member against the conductors and force detents against each of the contacts whereby the contacts are locked in position. In the event one or more of the conacts and/or conductors are to be replaced, the release means are actuated whereby all of the detents are released and the pressure on the sealing member is removed. The contacts and conductors may then be manually moved past the detents and through the passages in the insulating and sealing member. After all of the necessary changes have been made the release means are again tightened to lock all of the contacts in position.

These and other features and advantages of the present invention will become readily apparent from the following detailed description of the single embodiment thereof particularly when taken in connection with the accompanying drawings wherein like reference numerals refer to like parts and wherein:

FIGURE 1 is a side view of a pair of mating connectors embodying one form of the invention, a portion of said connectors being broken away,

FIGURE 2 is a fragmentary cross sectional view of one of the connectors in FIGURE 1 after it is separated from the mating connector, and

FIGURE 3 is a fragmentary end view of a connector of FIGURE 1.

Referring to the drawings in more detail the present invention is particularly adapted to be embodied in a pair of mating connectors **10** and **12**. The two connectors **10** and **12** are effective to interconnect the individual conductors in a first set **14** of conductors **16** with the respective individual conductors **20** in a second set **18**. It is to be noted that there may be a large number of conductors in each set and that the conductors in a set may be incorporated into a cable or they may be loose and separated from each other.

In the present instance, the first connector is a receptacle connector **10** and is permanently mounted on a bulkhead **22** such as a firewall. All of the conductors interconnected with the receptacle connector **10** are disposed on one side of the firewall **22** (the left side as seen in FIGURE 1). The second connector is a plug connector **12** adapted to be disposed on the opposite side of the firewall **22** (the right side as seen in FIGURE 1). The two connectors **10** and **12** will thereby be effective to individually interconnect the conductors in sets **14** and **18** disposed on the opposite sides of the firewall **22**.

The receptacle connector **10** includes a receptacle housing **24** having a mounting flange **26** that is secured to the bulkhead **22** by any suitable means such as bolts. A barrel **28** on the housing **24** extends through an opening in the firewall **22** so as to project from the right side thereof. A generally cylindrical passage **30** extends axially through the housing **24**.

An insert **32** is disposed in the passage **30** extending through the housing **24**. The insert **32** is preferably a relatively rigid member and includes an electrically non-conductive material. A plurality of small passages **34** extends through the insert **32** and form openings **36** and **38** in the front and back faces **40** and **42** of the insert **32**. Normally a separate passage **34** is provided for each conductor **16** in the set **14**. The exterior of the insert **32** is preferably a snug fit in the barrel **28**. An annular shoulder **44** may project into the passage **30** and engage the end of the insert **32**. The shoulder **44** thereby limits the travel of the insert **32** through the barrel **28**. Normally the shoulder **44** is positioned to maintain the front face **40** recessed inwardly from the end of the barrel **28**. In addition a ring **46** of adhesive material may be provided in mating recesses in barrel **28** and insert **32**. This will lock the insert **32** against the shoulder **44** and prevent movement of the insert **32** in either direction.

Although only single conductors **16** and **18** are shown it should be understood that normally there are a large number of such conductors **16** and **18** in each of the sets. The inner end of each conductor **16** in the set **14** has a contact **48** attached therethrough. In the present instance this is accomplished by inserting the conductor **16** into the end of the contact **48** and then crimping the contact **48** onto the conductor **16**. The opposite end of the contact **48** includes means such as a socket **50** for receiving a complementary portion of a mating contact in the mating or plug connector **12**. The diameter of the inner end of the passage **34** is reduced to form a shoulder. The shoulder engages the end of the contact **48** and prevents its moving through the passage **34**. In addition the inner end forms a guide which is aligned with the socket **50** in the connector **48**.

In order to prevent the contact **48** moving through the passages **34** in the reverse direction, a backup plate **52** may be provided. In the present instance the backup plate **52** is mounted in the passage **30** for sliding movement towards and away from the backface **40** of the insert **32**. The plate **52** includes a plurality of openings **54** that are aligned with the openings **38** in the insert **32** whereby the conductors **16** and contacts **48** may pass through the plate **52** and into the passages **34** in the insert **32**.

Detents **56** may be mounted on the backup plate **52** adjacent each of the openings **54** for locking the contacts **48** in position. In the present instance, each detent **56** includes at least one finger **58** that is bonded to the backup plate **52**. The ends of the fingers **58** are positioned to extend into the ends of the passages **34** and engage annular recesses **60** in the contacts **48**. The end of the passage **34** includes a clearance space **62** into which the fingers **58** may move. The fingers **58** may spring into the space **62** of their own accord and release the contact **48** for movement rearwardly through the passage **34**. However normally the fingers will remain in the recess **60** and retain the contact **48** in position. A small pulling force on conductor **16** causes the fingers **58** to be spread into the annular recesses **62** whereby the contact **48** will be extracted.

It has been found desirable to provide an insert seal **64** between the backup plate **52** and the insert **32**. A plurality of openings are provided in the insert seal **64** in alignment with the openings **54** in the backup plate **52** and the passages **34** in the insert **32**. When the backup plate **52** is moved toward the insert **32**, the insert seal **64** is compressed against the back face **42** of the insert.

The plug connector **12** is similar to the receptacle connector **10**. It includes a plug housing **66** having a generally cylindrical barrel **68** with a generally cylindrical passage **70** extending therethrough. The outside diameter of one end of the barrel **68** is reduced whereby the end fits snugly into the end of the passage **30**.

An engaging nut **72** or similar fastening means are rotatably mounted on the outside of the barrel **68**. A thrust ring **74** is provided to prevent the nut **72** moving axially of the barrel **68**. The interior of the nut **72** is threaded so as to engage complementary threads on the exterior of the barrel **28**. As a result by rotating the nut **72**, it will be possible to force the plug barrel **68** into the receptacle barrel **28** and lock the two connectors **10** and **12** together.

An insert **76** similar to the first insert **32** is disposed in the passage **70** so as to engage the shoulder **78**. A ring **80** of adhesive material is also provided to lock the insert against the shoulder. This insert **76** is also a relatively rigid member of an electrically non-conductive material having a front face **82** and a rear face **84**. A plurality of passages **86** extend axially through this insert **76** and form openings **88** in the front face **82** aligned with the openings **36** in the front face **40** of the first insert **32**.

The end of each conductor **20** in the second set **18** has a contact **90** attached thereto by some suitable means such as crimping. The end of each contact **90** includes means such as a pin **92** for engaging the complementary portion of the mating contact **48** in the receptacle connector **10**. The end of each passage **86** has a reduced diameter whereby a shoulder **94** is formed that engages the contact **90** and prevents its moving completely through the passage **86**.

The pins **92** extend through the ends of the passage and beyond the front face **82** of the insert **76**. The exposed portion of the pin **92** may pass through the openings **36** in the front face **40** of the first insert **32** and into the socket **50** in the ends of the contacts. This will form a low resistance electrical path between the conductors **16** and **20** in the two sets **14** and **18**. When the nut **72** is tightened onto the barrel **28** the contacts **48** and **90** will be locked in this condition.

In order to insure a seal between the two inserts **32** and **76** an inner face thrust seal **96** may be provided. This is a resilient member capable of being compressed between the front faces **40** and **82** when the nut is tightened. The compressed sealing member **96** will thereby form an effective moisture barrier that protects the contacts **48** and **90**.

In order to secure the contacts **90** in position in the passages **86**, a backup plate **98** may be provided inside of the barrel **68**. This plate **98** is slidably disposed in the passage **70** for movement towards and away from the back face **84** of the insert **76**. The plate **98** includes a plurality of openings aligned with the passages **86** in the insert **76**. As a consequence the conductors **20** with the contacts **90** thereon may extend through these openings and into the passages **86** in the insert **76**. It has been found desirable to provide an insert seal **100** on the backup plate **98**. When the backup plate **98** is forced against the insert **76**, the seal **100** will be tightly compressed whereby a moisture proof barrier will be formed.

Detent means **102** are mounted on the backup plate **98** for securing the contacts **90** in position. The present detents **102** include spring fingers **104** that are positioned to extend into the passages **86** in the insert **76** and engage an annular recess **106** in the exterior of the contacts **90** whereby the contacts **90** are locked in position. A clearance space **108** may be provided in each passage **86** whereby the fingers **104** may move out of the recesses **106** and release the contacts **90** when the conductor **18** is pulled.

The backup plates **52** and **98** in the two connectors **10** and **12** are substatnially identical to each other and are free to slide axially through their respective passages **30** and **70**. In order to control the axial positions of the backup plates, adjustable means such as compression nuts **110** and **112** are mounted on the ends of each barrel **28** and **68**. Each of the nuts **110** and **112** is threaded onto its respective barrel **28** and **68** whereby the nuts may be moved axially along the barrels. Each nut **110** and **112** is coupled to its respective backup plate **52** and **98** by a ferrule **114** and **116** and a grommet seal **118** and **120**.

The grommet seal **118** and **120** is a resilient member having an inner face **122** and outer face **124**. The inner

faces **122** are adapted to engage the adjacent backup plate **52** or **98** and compress it towards the insert **76**. A plurality of passages **126** extend through the seals **118** and **120** and form openings in front and rear faces. These passages **126** are substantially aligned with the passages in the inserts **32** and **76** whereby the conductors **16** and **20** may extend through the seal and into the inserts.

The inside diameters of the passages **126** are preferably a snug fit around the exterior of the conductors. However, the passages **126** are sufficiently large and the seal sufficiently resilient to permit a conductor and the connector on the end thereof to be forced through the passage **126** without damaging the seal. In this regard it is desirable for the friction to be large enough to prevent an accidental pulling of the conductors from the connector.

The ferrules **114** and **116** which are free to slide along the inside of the passages **30** and **70** are disposed between the grommet seals **118** and **120** and the barrels. One end of each ferrule **114** and **116** is disposed therebetween a ring **128** and a shoulder **130** on the nuts **110** and **120**. As a consequence rotating the nuts **110** or **120** about the barrel will move the associated ferrule **114** or **116** in an axial direction.

The second ends of the ferrule **114** and **116** include hooks **132** which fits over the edges of the backup plates **52** and **98** whereby the plates may be moved. The ferrules also include ramps **134** that slide against similarly tapered surfaces **136** on the exteriors of the seals **118** and **120**.

It can be appreciated that when a nut **110** or **120** is tightened the ramp **134** on the associated ferrule will engage the tapered exterior **136** and force the grommet seal, inwardly and toward the backup plate. As this motion progresses the backup plate **52** or **98** and insert seal **64** or **100** will be forced against the rear face of the insert **32** or **76**. This in turn will force the fingers **58** or **104** in the detents **56** or **102** carried by the backup plates to move through the passages and into the recesses on the contacts **48** or **90**. At some point in the tightening process, the ramp **136** will begin to compress the grommet seal radially inwardly. As this compression builds up the seal will also be forced inwardly against the conductor and form a moisture proof barrier.

If the nut **120** is loosened it will move into the position shown in FIGURE 2. During the loosening process the hook **132** will engage the backup plate **98** and pull it away from the insert **76**. At the same time the compression seal **120** will be released so that the backup plate **98** and seal **100** can move axially. During this movement the ends of the fingers **104** will be withdrawn and spring outwardly into the clearance spaces **108** and disengage the recesses in the contacts. As a consequence the conductor and contact may be pulled through the grommet **112** so as to be replaced.

It will thus be seen that a connector is provided wherein the contacts and conductors are securely locked in position. However in the event it is desired to change or replace a contact it is not necessary to employ a special tool. Instead the compression nut **110** or **120** may be loosened. This will then release the detents **56** or **102** and the grommet seal **118** or **120**. The conductor and contact may then be removed by manually pulling on the conductor. The new contact may then be manually forced through the passage in the seal and into passage. The detent will then lock the contacts in position. Following this the nut is tightened until the seal and detents are firmly locked in position. The grommet seal **118** and **120** provide enough friction on the conductors **16** and **20** to preclude their being accidentally pulled out of the seals.

We claim:

1. A connector for being interconnected with a mating connector, said connector including the combination of
- a connector housing for being coupled to the mating connector,
- an insert in said housing,
- a resilient sealing member disposed in said housing,
- a plurality of aligned passages extending through said insert and sealing member,
- a contact and conductor disposed in each of said passages,
- detents on each of said contacts,
- a support member disposed inside of the housing between the insert and sealing member for movement between a first position and a second position,
- a separate retainer on said support member for each contact, said retainers engaging the detents when the support member is in one of said positions and thereby locking the contacts and conductors in the passages, said retainers disengaging the detents when in the other of said positions and releasing the contacts and connectors, and
- means coupled to said members for moving the support member into the first position and compressing the sealing member against the conductors.

2. A connector for being interconnected with a mating connector, said connector including the combination of
- a connector housing for being coupled to the mating connector,
- an insert of insulating material disposed in the housing,
- a resilient sealing member disposed in said housing,
- a plurality of aligned passages in said insert and sealing member,
- a contact disposed in each of said passages and having detents thereon,
- a support member disposed inside of the housing between the insert and sealing member for movement between a first position adjacent the insert and a second position therein separated from the insert,
- fingers on said support member for each contact, said fingers extending into said passages and engaging the detents when the support member is in the first position and thereby locking the contacts in the passages, said fingers disengaging the detents when in the other of said positions and releasing the contacts, and
- means on said housing for moving the support member between the first and second positions, said means being effective to compress the sealing member when the support member is in the first position.

3. A connector for being interconnected with a mating connector, said connector including the combination of
- a connector housing for being coupled to the mating connector,
- an insert of insulating material disposed in the housing,
- a resilient sealing member disposed in said housing,
- a plurality of aligned passages extending through said insert and sealing member,
- a contact and conductor disposed in each of said passages,
- detents on each of said contacts,
- a plurality of fingers movable between a first position and a second position,
- said fingers engaging the detents when in the first position and thereby locking the contacts and conductors in the passages, said fingers disengaging the detents when in the second position and releasing the contacts and connectors, and
- means coupled to the fingers and the sealing member for moving the fingers between the first and second positions, said means being effective to compress the sealing member when the fingers are in the second position.

4. A connector for being interconnected with a mating connector, a connector including the combination of
- an insert of an insulating material,
- a plurality of contacts disposed in said insert,
- a detent on each of said contacts,
- a support member movable between an inner position adjacent the insert and an outer position remote from the insert, and

at least one finger for each contact mounted on the support member for movement therewith, said fingers engaging the detent on its respective contact and locking the contact in position when the support member is in the inner position and spreading and releasing said detents when the support member is in the outer positions.

5. A connector for being interconnected with a mating connector, a connector including the combination of

an insert of an insulating material,

a plurality of passages in said insert,

a contact disposed in each of said passages,

a detent on each of said contacts,

a support member movable between an inner position adjacent the insert and an outer position remote from the insert,

at least one finger for each contact mounted on the support member for movement therewith, said fingers when in the inner position extending into the passages and being compressed against the detent and locking the contacts in position, said fingers when in the second position being spread beyond said detents and releasing the contacts.

6. A connector for being interconnected with a mating connector, said connector including the combination of

a connector housing for being coupled to the mating connector,

an insert disposed in said housing,

a plurality of contacts disposed in said insert,

a support member in said housing movable between a first position adjacent the insert and a second position separated from the insert,

a separate retainer for each contact carried by said support member for movement therewith, each of said retainers when in one of said positions engaging its respective contact and locking said contacts in position said retainers when in the other of said positions disengaging and releasing the contacts, and

means on said housing coupled to the support member for moving said member between the first and second position.

7. A connector for being interconnected with a mating connector, said connector including the combination of

an insert member of insulating material,

a sealing member of resiliently deformable material disposed adjacent said insert,

a plurality of aligned openings in said members,

a contact disposed in said openings, each of said contacts having detents thereon,

a support member disposed adjacent the insert for movement between a first position adjacent the insert and a second position remote from the insert,

a separate retainer on said support member for each of said contacts, said retainers extending into the insert when the support member is in the first position to thereby engage the detents and lock the contacts in position, said retainers being effective to disengage the detents and release the contacts when the support member is in the second position, and

means for moving the support member between said positions and compressing the sealing member.

8. A connector for being interconnected with a mating connector, said connector including the combination of

an insert,

a plurality of contacts disposed in said insert and having detents thereon,

each of said contacts being movable between first and second positions, said detents being disposed in said insert when the contacts are in the first position,

a support member disposed adjacent the insert for movement toward and away from the insert, and

a separate retainer on said support member for each of said contacts, each of said retainers extending into the insert and engaging the detent on its respective contact when the support member is moved toward said insert member to thereby lock the contact in the first position, said retainers disengaging the detents and releasing the contacts when the support member moves away from the insert.

9. A connector for being interconnected with a mating connector, said connector including the combination of

an insert of insulating materials,

a plurality of openings in said insert,

a contact disposed in each of said openings, said contacts being adapted for movement into an operative position in its respective opening,

a detent on each of said contacts, and

a retainer for each contact movable between first and second positions, said retainers when in one of said positions extending at least partially into the openings to engage the detents and lock the contacts in the operative position, said retainers when in the other of said positions disengaging the detents and releasing the contacts for movement out of the operative position.

10. A connector for being interconnected with a mating connector, said connector including the combination of

an insert of insulating materials,

a plurality of contacts disposed in said insert for movement between an operative position and an inoperative position,

a detent on each of said contacts

a retainer for each of said contacts movable between first and second positions, said retainers including a plurality of fingers engaging the detents and locking the contacts in the insert when the retainer is in the first position, said fingers spreading away from the detents when the retainer moves into the second position to release the contacts.

References Cited

UNITED STATES PATENTS

2,619,515	11/1952	Doane	339—94
2,700,140	1/1955	Phillips	339—94
2,963,536	12/1960	Kokalas	339—103 X
3,028,574	4/1962	Di Monte	339—217 X
3,040,287	6/1962	Agron et al.	339—103 X
3,066,272	11/1962	Quackenbush	339—217 X
3,227,993	1/1966	Bentley	339—217 X
3,266,009	8/1966	Jensen et al.	339—94 X

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