Dec. 26, 1967 J. F. LANCASTER 3,360,747

SELF-NORMALING JACK BARREL ASSEMBLY
WITH IMPEDANCE BALANCING ELEMENT

Filed July 19, 1965 5 Sheets-Sheet 1

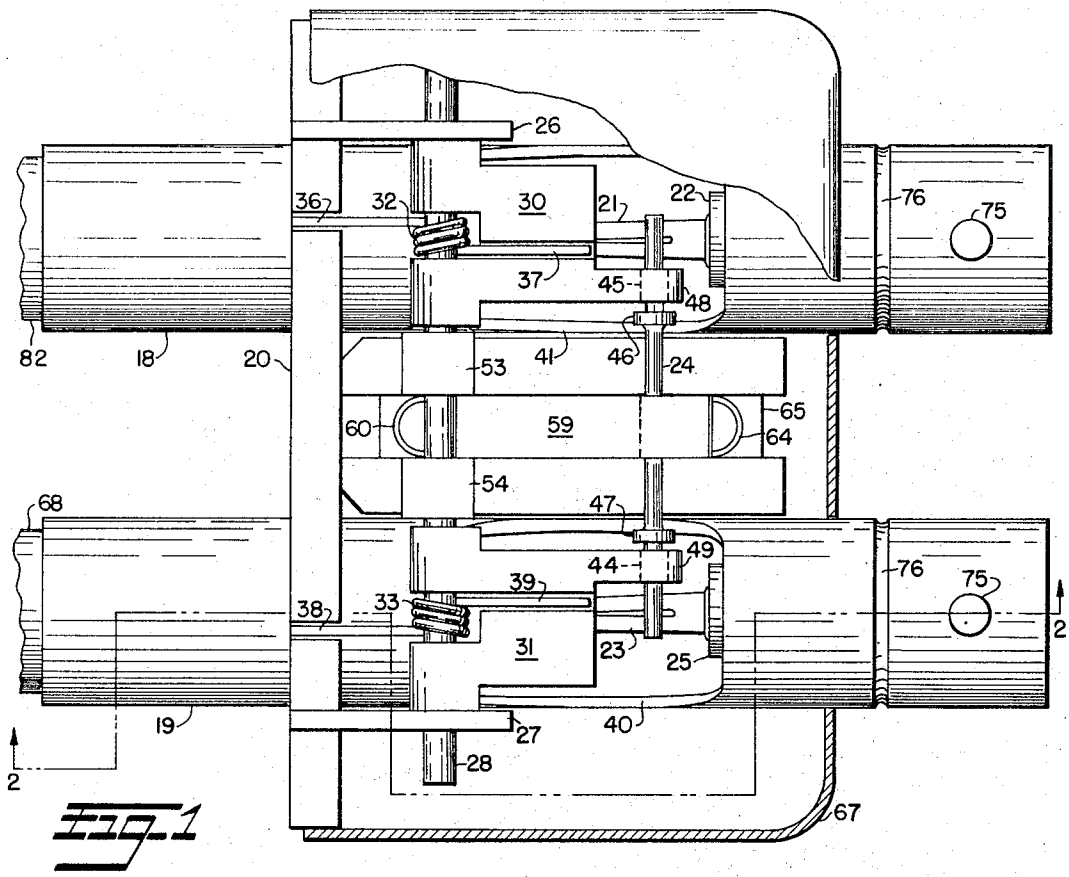



Fig. 1

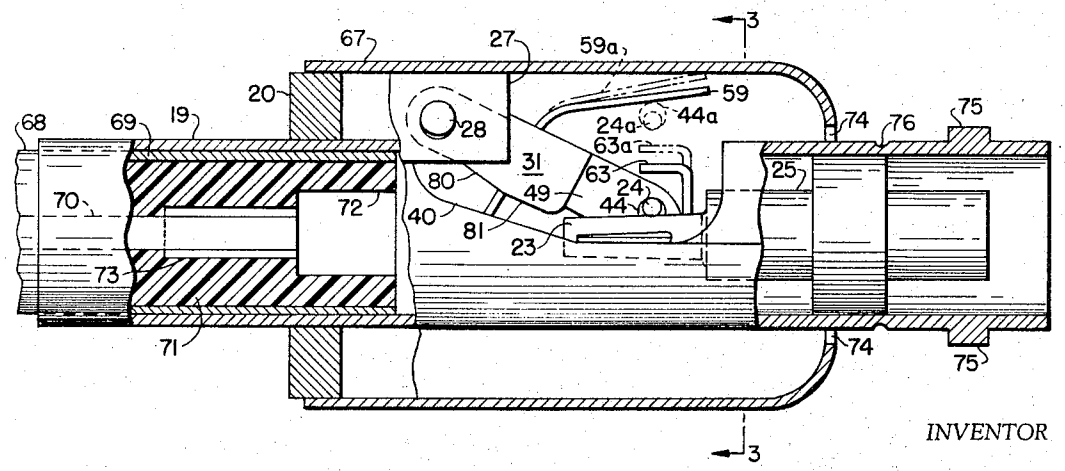



Fig. 2

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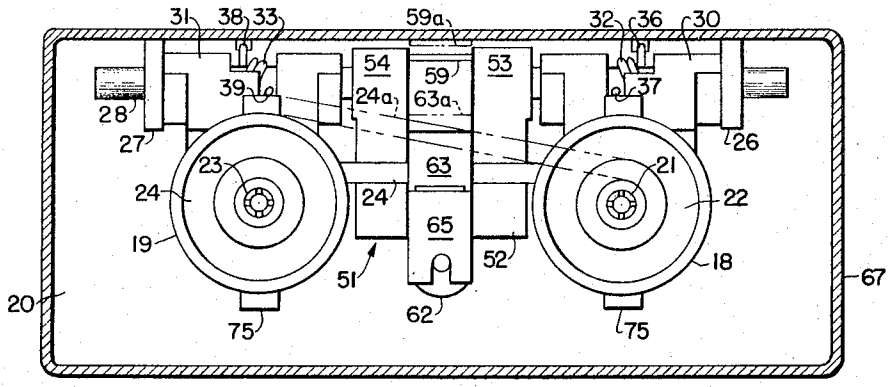



Fig. 3

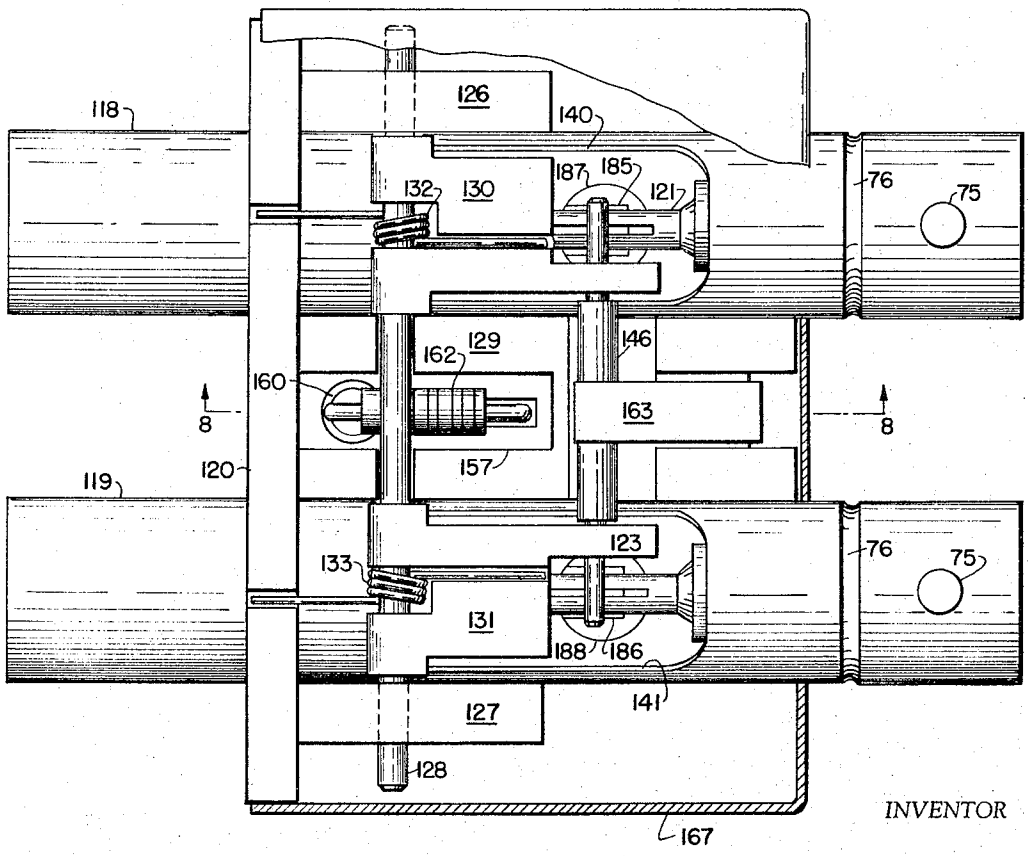



Fig. 1

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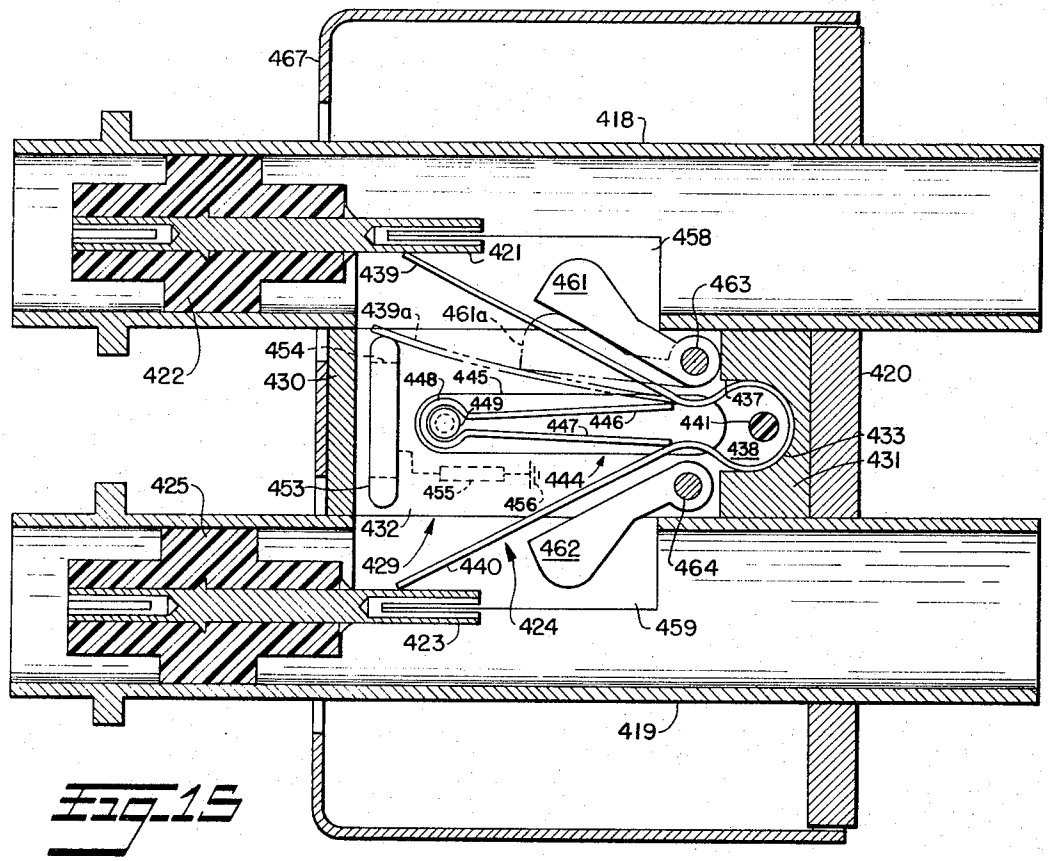
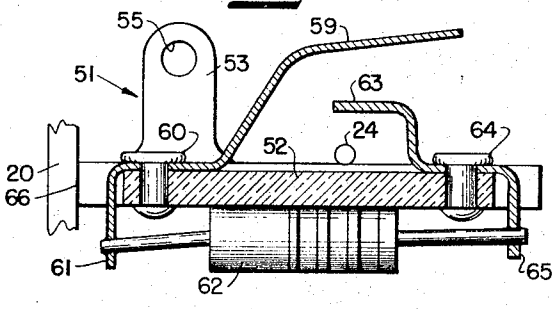



Fig. 1S

Fig. 4



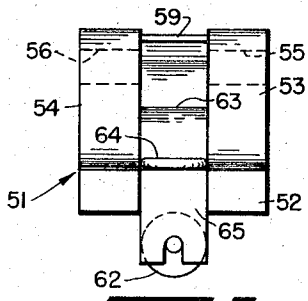
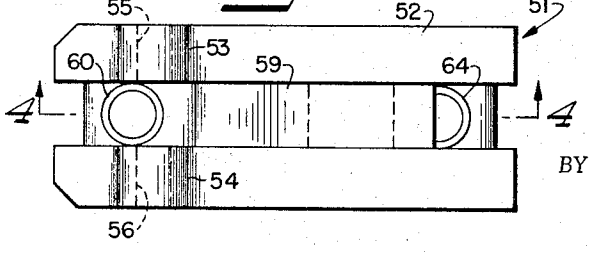




Fig. 6

Fig. 5




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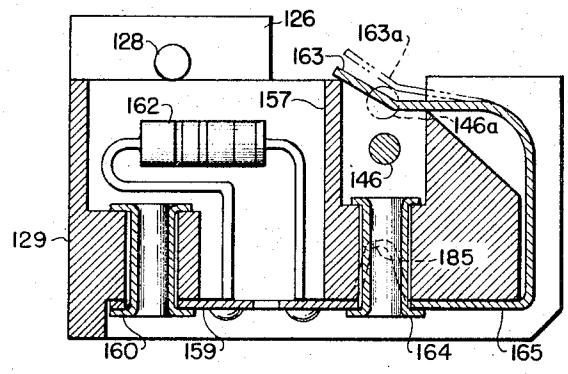



Fig. 8

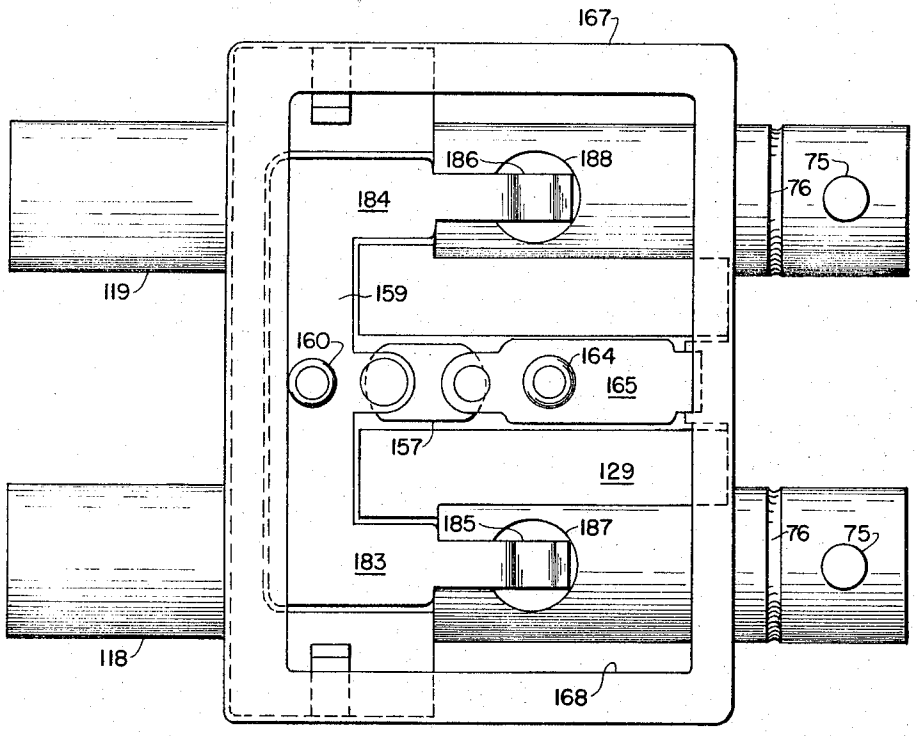



Fig. 9

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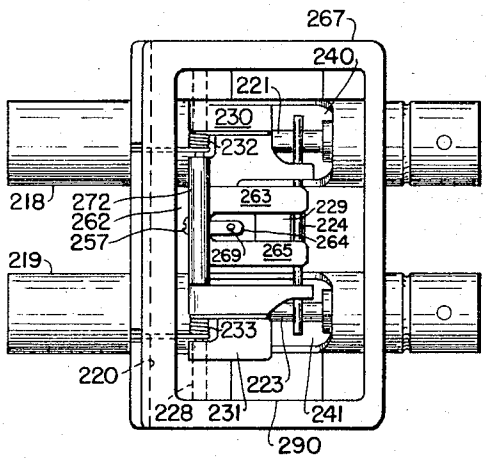



Fig. 10

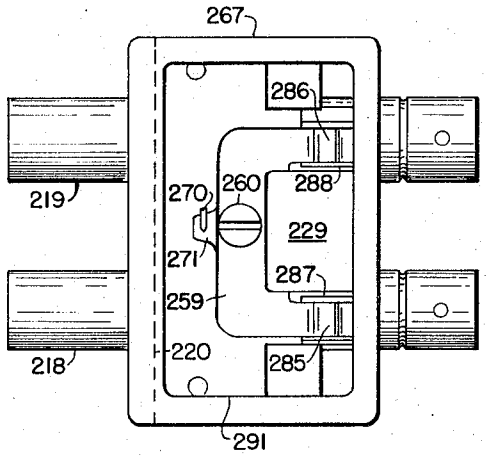



Fig. 11

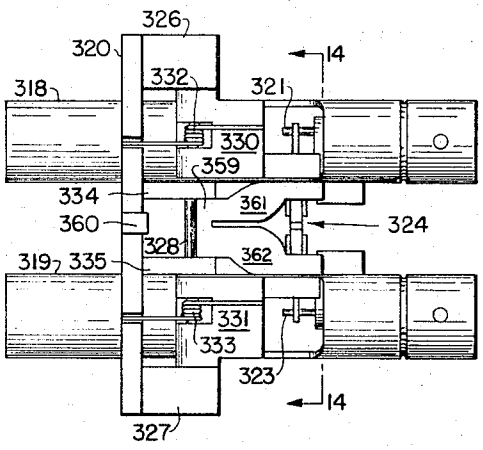



Fig. 12

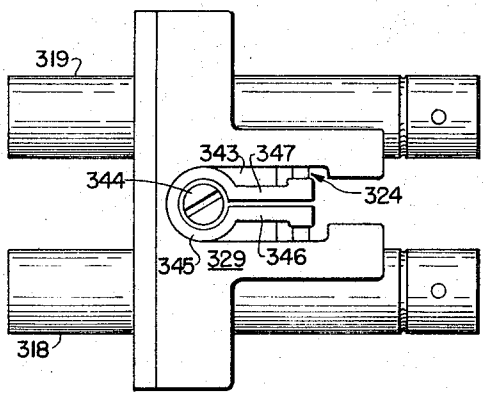



Fig. 13

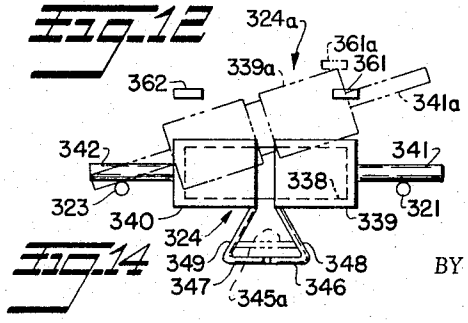



Fig. 14

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United States Patent Office 3,360,747 Patented Dec. 26, 1967



3,360,747

# SELF-NORMALING JACK BARREL ASSEMBLY WITH IMPEDANCE BALANCING ELEMENT

Jesse F. Lancaster, Great Falls, Va., assignor to Cooke Engineering Company, Alexandria, Va., a corporation of Delaware

Filed July 19, 1965, Ser. No. 472,977
10 Claims. (Cl. 333—9)

This invention relates to jacks for connecting coaxial cables together or for selectively disconnecting them and connecting them to other cables. In particular, the invention relates to a self normalling jack which in its normal condition connects a coaxial cable from video or other radio frequency energy source to a similar cable leading to a load, but wherein patchcords may be inserted into the jack to connect the energy source to a different load or to connect the load to a different source.

Jacks of this type have internal switching devices for disconnecting the normally connected source and load upon the insertion of a patchcord or dummy plug. They usually comprise a pair of jack barrels rigidly mounted in parallel upon a plate and a number of the jacks are mounted on a panel to provide a jackfield so that patchcords may be inserted into selected jacks to connect different circuits together as needed. The jacks may include resistors and other devices that match the characteristic impedance of a circuit connected to it, so that the cable leading thereto may be properly terminated when the circuit is disconnected at the jack.

Jacks of the type to which the invention pertains are exemplified by the Patents 2,958,054 issued Oct. 25, 1960 to Concelman; 3,020,365 issued Feb. 6, 1962 to Neenan; 3,109,997 issued Nov. 5, 1963 to Giger et al.; 3,117,193 issued Jan. 7, 1964 to Hirshfeld et al. and 3,036,169 issued May 22, 1962 to Kienlen et al.

All of the illustrated embodiments of the invention are of simplified rugged construction, leading to low cost, long life, ready assembly, permitting miniaturization and providing low cross talk and noise pickup.

Several embodiments are improved and refined versions of the jack shown in the aforementioned Patent 3,036,169 issued May 22, 1962 to Kienlen et al.

All provide resistor means for matching and terminating a disconnected cable with an impedance matching the circuit to which the disconnected cable leads.

It is accordingly a primary purpose of the invention to provide an improved self normalling jack for connecting or disconnecting coaxial cables or for connecting them to other cables.

Another important object is to provide a self normalling jack having features of construction that permit miniaturization and yet lead to a rugged device that is readily assembled.

Still another important object of the invention is the provision of improved and novel means for terminating a disconnected coaxial cable by connecting its inner and outer conductors through a resistor balanced for the characteristic impedance of the circuit to which the cable leads.

Other objects will become apparent as the description proceeds in connection with the accompanying drawings, wherein:

FIGURE 1 is a top plan view of one embodiment of a self-terminating unit with a portion of the cover removed to expose the switch parts.

FIGURE 2 is a vertical sectional view substantially along the line 2—2 of FIGURE 1.

FIGURE 3 is an end view of the unit of FIGURE 2 as viewed from the right in FIGURE 2 and with the cover alone cut away substantially along the line 3—3 of FIGURE 2 to expose the switch parts.



FIGURE 4 is a view in side elevation, partly in section of an insulator block assembly used in the embodiment of FIGURES 1 to 3.

FIGURE 5 is a top plan view of the assembly of FIGURE 4.

FIGURE 6 is a side view of the assembly of FIGURE 4, as seen from the right of FIGURE 4.

FIGURE 7 is a top plan view of a second embodiment of a self terminating unit with a portion of the cover removed to expose the switch parts.

FIGURE 8 is a vertical sectional view substantially along the line 8—8 of FIGURE 7, but with some parts omitted.

FIGURE 9 is a bottom view of the unit of FIGURE 7, with a portion of the cover removed to expose the switch parts.

FIGURES 10 and 11 are top plan and bottom views respectively of a third embodiment, with portions of the cover removed in each case to expose the switch parts.

FIGURES 12 and 13 are top plan and bottom views respectively of a fourth embodiment, with portions of the cover removed in each case to expose the switch parts.

FIGURE 14 is an enlarged side view of a portion only of the shorting rod and associated contacts, as viewed substantially from the line 14—14 of FIGURE 12.

FIGURE 15 is a horizontal sectional view taken substantially through the center of a fifth embodiment of the invention.

Referring to FIGURES 1 to 3, wherein is shown one form of a normal-through coaxial switching and line terminating jack, a pair of tubular metal jack barrels or shields **18** and **19** extend through and are rigidly secured to a common metallic bar **20**. Within jack barrel **18** is a conductor **21** fixedly mounted centrally therein by an insulator **22** and within jack barrel **19** is a similar central conductor **23** fixedly mounted therein by an insulator **25**. A transverse conductor or shorting rod **24**, in its normal position, connects the central conductors **21** and **23**. Thus if two coaxial cables are connected to the jack by connectors, not shown, by inserting them into the right ends of jack barrels **18** and **19** the two coaxial cables are connected together by the normal-through jack shown, when the transverse conductor or shorting rod **24** is in its normal position engaging both central conductors **21** and **23**. The outer conductors of the cables are connected via barrels **18** and **19** and bar **20**. The coaxial cable connected to jack barrel **18** may lead from a video or other radio frequency source, in which case the coaxial cable connected to the other jack barrel **19** will lead to a corresponding load. The construction by which the coaxial cables connected to the right ends of barrels **18** and **19** may be either terminated at the jack or else connected to another source or load will now be described.

A pair of spaced ears **26** and **27**, are affixed to the bar **20** as by soldering or brazing and are transversely drilled to receive a hinge pin **28** which has a sliding fit therein, the hinge pin being above the barrels **18** and **19** as viewed in FIGURES 2 and 3. A pair of shorting rod levers **30** and **31** of insulating material, which are similar but reversed in plan outline as viewed in FIGURE 1, are pivotally mounted upon the hinge pin **28** and their outer free ends are resiliently urged clockwise, as viewed in FIGURE 2, toward the central conductors **21** and **23**, by springs **32** and **33** having their coils mounted on hinge pin **28**. The spring **32** has a protruding leg **36** received in a groove in the edge of bar **20** and a substantially oppositely protruding leg **37** received in a groove in the upper surface of the shorting rod lever **30**, and the spring is so tensioned as to urge the lever **30** toward the conductor **21** as previously mentioned. Spring **33** is similarly tensioned and has protruding legs **38** and **39** similarly received in slots in bar **20** and the other lever **31**.

The upper portions of the jack barrels **18** and **19**, as viewed in FIGURE 2, are cut away as indicated at **40** in FIGURE 2 and at **40** and **41** in FIGURE 1, to provide access to the interior of the barrels by the shorting rod levers **30** and **31** to move the shorting rod **24** toward and away from the central conductors **21** and **23**, and also to provide room for movement of the shorting rod itself since it extends between and overlies the central conductors within the barrels.

Adjacent its free end the lever **31** has a bore **44**, which as best shown in FIGURE 2 is about twice the diameter of the shorting rod **24**, which passes therethrough with a very loose fit. The other lever **30** has a similar large bore **45** for the passage of the rod **24**. A pair of spaced shoulders **46** and **47** (FIGURE 1) on the shorting rod **24** are larger in diameter than the aforesaid bores **44** and **45** and axially spaced so as to permit substantial axial movement of rod **24** but to prevent its withdrawal from either bore **44** and **45** during operation of the jack. The bores **44** and **45** are in relatively narrow extending leg portions **48** and **49** on the free ends of the shorting rod levers **30** and **31** respectively, which portions extend downwardly and between the central conductors **21** and **23** so that the shorting rod **24** can engage the central conductors when in the normal position, as best seen in FIGURE 2.

Also pivotally mounted upon the hinge pin **28** is a block of insulating material designated generally by the reference numeral **51** in FIGURES 3 to 6. The block **51** comprises a substantially rectangular base **52** and a pair of spaced upstanding legs **53** and **54** having aligned bores **55** and **56** therethrough by which the block is mounted upon the pin **28**. A ground contact leaf spring **59** is secured to the top of base **52** as by a rivet **60** and has a leg **61** depending below the base to which is soldered one lead of a balancing resistor **62**. A resistor contact leaf spring **63** has a free end extending between the base **52** and the free end of ground contact spring **59**, overlying the shorting rod **24**. It is secured to the top of base **52** by a rivet **64** and has a leg **65** depending below the base and to which is soldered the other leg of the resistor **62**.

Clockwise rotation of the insulator base **52** beyond a substantially horizontal position as viewed in FIGURES 2 and 4 is prevented by engagement of its left end **66** with the metal bar **20**. It is resiliently held in this position by the shorting bar **24** when the shorting bar is engaging both central conductors **21** and **23**, and in this position the shorting bar is spaced below and does not engage the resistor contact leaf spring **63**, as best shown in FIGURES 2 and 4.

A metallic box-like shielding enclosure **67** encloses all of the movable parts of the switch. It has a tight fit over the metallic bar which forms one wall of the enclosure. Slots **74** (FIGURE 2) adjoining the openings for the barrels **18** and **19** permit the enclosure to slip over the prongs **75** on the barrels which are engageable by conventional coaxial cable BNC connectors. Ring grooves **76** are also provided so that connectors disclosed in the copending application Ser. Number 471,105 filed July 12, 1965, now Patent No. 3,325,767 by Jesse F. Lancaster for "Connector" may be used on the coaxial cables.

The jack has so far been described in its normal condition, with the two coaxial cables (not shown) attached to the right hand ends of jack barrels **18** and **19** connected to each other by engagement of the shorting rod with both central conductors **21** and **23**.

The circuit can be broken by inserting a dummy plug into the left end of either jack barrel **18** or **19** or by inserting a patchcord into either jack barrel. Patchcords may be inserted into both barrels at their left ends, but the connection between central conductors **21** and **23** will be broken upon insertion of the first one, as will be apparent from the following description.

FIGURE 2 shows the end of a patchcord **68** partially inserted into the left end of jack barrel **19**. The patchcord includes an outer metal tube **69** which has a sliding fit within the jack barrel, a central conductor **70**, and a tubular insulator **71** separating the central conductor from the metal tube **69**. At its right end the insulator has a counter-bore **72** to receive the reduced diameter left end of insulator **25**. Central conductor **70** extends to the left end of counter-bore **72**, and surrounding the right end portion of the central conductor **70** is a second small counter-bore **73** so that when the patchcord **68** is fully inserted into jack barrel **19** there will be room for the prongs of the fixed central conductor **23**, which surround and engage the end of conductor **70** when the patchcord is fully inserted.

Referring still to FIGURE 2, as the patchcord **68** is inserted, continued movement to the right from the position shown will result in engagement of the leading edge of the metallic tube **69** with a camming surface **80** on the bottom face of the shorting rod lever **31**, turning the lever counterclockwise about the hinge pin **28**. Further movement of the patchcord to the right, into full engagement with the contact **23** results in rotating the lever to its fully raised position, in which it is substantially horizontal with a flat portion **81** on its bottom surface engaging the top of the tube **69** of the patchcord. The bore **44** in the outer end of the lever is then in the position shown in dot dash lines at **44*a*** and the end of the shorting rod **24** passing therethrough is in the position shown at **24*a***. The other end of the shorting rod **24** is still engaged against the other central contact **21**, being retained thereagainst by the spring **32** and shorting rod lever for the other jack barrel **18**, and the shorting rod is in the inclined position shown at **24*a*** in FIGURE 3. The loose fit of the shorting rod in the bores **44** and **45** in the levers permits this. In its movement to this inclined position the mid-portion of the shorting rod engages the underside of the resistor leaf spring and raises it to the position **63*a*** in FIGURES 2 and 3. This rotates the insulator block **51** counterclockwise and raises the ground contact leaf spring **59** to the position shown at **59*a*** in FIGURES 2 and 3, in which position the spring **59** contacts the metallic shielding enclosure **67**, thus grounding the central conductor **21** in jack barrel **18** by way of shorting rod **24**, resistor contact leaf spring **63**, resistor **62** and the ground contact spring **59**. The latter becomes stressed upon engagement with enclosure **67** and resiliently urges the insulator block **51** clockwise so that the resistor contact leaf spring will maintain firm contact with the central portion of the shorting rod.

In this condition the patchcord **68** in jack barrel **19** is now fully connected to the coaxial cable connected to the right hand end of the jack barrel and leading to a load, and the cut away opening **40** in the upper portion of the jack barrel is fully covered by the metal tube **69** of the patchcord. Also, the coaxial cable connected to the right hand end of the other jack barrel **18** is terminated, being grounded through the resistor **62** to the enclosure **67**. The value of the resistor **62** is selected in accordance with the impedance of the circuit connected to the right ends of the jack barrels. Normally a video or other radio frequency source is connected to barrel **18** and a load to barrel **19**.

With the patchcord **68** leading to an alternate video or other radio frequency source fully inserted into the jack barrel **19** the load connected to the right end of the jack barrel is now supplied by the alternate source. Withdrawal of the patchcord **68** will lower the shorting rod **24** and re-establish the connection between the central connectors **21** and **23**. Lowering of the shorting rod will also lower the insulator block **51**, disengaging spring **59** from the enclosure **67** and spring **63** from the shorting rod.

If it is desired to connect the energy source connected to the right end of jack barrel **18** to another load, then a patchcord **82**, similar to patchcord **68**, but leading to the other load may be inserted into the left end of jack barrel **18**. This will raise the right end of shorting rod **24** as viewed in FIGURE 3, disengaging it from the central conductor. If at this time there is already a patchcord inserted

in the other jack barrel **19** then the shorting rod **24** will be level, with both ends raised to the same level as the left end of the dot-dash view of the rod at **24***a* in FIGURE 3. This will raise the resistor contact leaf spring **63** to a position higher than indicated at **63***a*, against the force of ground contact leaf spring **59** which will remain at position **59***a*, in engagement with the enclosure **67**. If the patchcord should now be removed from the jack barrel **19** the right end of shorting rod **24** as viewed in FIGURE 3 will remain elevated and its left end will be lowered into engagement with the central conductor **23**, grounding it via contact leaf spring **63**, resistor **62** and spring **59** to the enclosure **67**.

Assuming, as before, that central conductor **21** in jack barrel **18** is connected to a video or other radio frequency source, and that central conductor **23** in jack barrel **19** is connected to a receiver as a load, the grounding of the receiver central conductor **23** via the balancing resistor **62** upon disconnection from the source central conductor **21** will prevent the receiver from going into oscillation and affecting other circuits.

If it is only desired to disconnect central conductor **21** from central conductor **23** rather than perform a switching operation by the insertion of patchcords as described above, a dummy plug inserted into either jack barrel will perform the disconnection by raising the corresponding end of the shorting rod away from the central contact. If central contact **23** is connected to a receiver it is preferable to insert the dummy plug into the jack barrel **18** so that the central contact **23** is grounded, preventing possible oscillation of the receiver. The dummy plug may be similar to a patchcord plug, omitting the central conductor therein.

In the embodiment illustrated in FIGURES 7, 8 and 9 a pair of jack barrels **118** and **119** are rigidly secured to a common metallic bar **120**, the jack barrels have central insulated conductors **121** and **123** and a shorting rod **124** is loosely mounted in bores in the outer ends of shorting rod levers **130** and **131** of insulating material, hinged on pin **128**, which resiliently hold the shorting rod against the central conductors **121** and **123** under the action of springs **132** and **133**, all as in the first embodiment. A block **129** of insulating material, shown in section in FIGURE 8, has a pair of spaced upwardly extending legs **126** and **127** in which is mounted a hinge pin **128** that supports the levers **130** and **131** and their springs **132** and **133**. The block **129** is rigidly secured to the metal bar **120** as by screws, not shown.

Mid-point of the length of block **129**, mid-point between the jack barrels **118** and **119**, a resistor contact leaf spring **163** is mounted, being secured thereto by a hollow rivet **164** through a leg **165** of the spring **163** that extends beneath the block **129**. The latter has a vertical passageway **157** therethrough, in which is located a balancing resistor **162** one lead of which is soldered to the leg **165**, the other lead being soldered to a ground contact leaf spring **159** which is secured to the underside of block **129** by a hollow rivet **160**.

As shown in FIGURE 9 the ground contact leaf spring **159** extends away from the rivet **160** on opposite sides thereof and terminates in two legs **183** and **184** underlying the jack barrels **118** and **119** respectively and extending to the right ends thereof to which coaxial cables are connected. Near their right ends the legs **183** and **184** of the spring **159** have upwardly deformed portions forming contacts **185** and **186** which protrude through openings **187** and **188** through the bottom walls of jack barrels **118** and **119**. The contact **185** is best shown in FIGURE 8. Both contacts **185** and **186** protrude through these openings so as to lie in the path of the external metal tubes of either patchcords or dummy plugs inserted into the left ends of jack barrels **118** or **119**. Thus when a patchcord or dummy plug is fully inserted, the left lead of the balancing resistor is grounded by way of ground contact spring **159**, leg **183** or **184**, contact **185** or **186**, jack barrel **118** or **119**, and metallic bar **120**. As will be understood, the contacts **185** and **186** do not engage any portion of the jack barrels **118** or **119** at any time.



In the normal condition of the switch of this embodiment the shorting rod **124** engages the central conductors **121** and **123**. It has a loose fit in the free ends of the shorting rod levers **130** and **131** and has an enlarged central portion **146** to keep it from slipping axially out of the levers. In this condition the enlarged portion **146** of the shorting rod is substantially in the position shown in FIGURE 8. Upon full insertion of a patchcord or dummy plug into either jack barrel one end of the shorting rod will be raised out of engagement with its central conductor, and the mid-point of its enlarged portion will be at the position **146***a* of FIGURE 8, where it has engaged and raised the free end of the resistor contact leaf spring **163** to the position indicated at **163***a*. This grounds the central conductor in the other jack barrel through the shorting rod, spring **163**, resistor **162**, ground contact spring **164** and the external metallic tube on the inserted patchcord or plug. Inserting a patchcord into the other jack barrel will raise the other end of the shorting rod **124** from engagement with its central conductor so that both ends will be elevated and its enlarged central portion **146** will be higher than the position indicated at **146***a* in FIGURE 8, but still in engagement with the spring **163**.

As in the case of the first embodiment, the upper portions of the jack barrels are cut away at **140** and **141** to provide access for the shorting rod and its levers **130** and **131**, these openings being closed when a patchcord or dummy plug is inserted into a jack barrel. A metallic shielding enclosure **167** encloses the mechanism, it being cut away at **168** in FIGURE 9 to expose the internal parts.

The embodiment of FIGURES 10 and 11 is similar in many respects to that of FIGURES 7, 8 and 9. Its jack barrels **218** and **219** have cut away portions **240** and **241** to provide access to the interiors thereof and to permit movement of a shorting rod **224** and its shorting rod levers **230** and **231** toward and away from the central conductors **221** and **223** therein. A mounting block **229** of insulating material is secured to a metal bar **220** to which are rigidly secured the jack barrels **218** and **219**. Block **229** includes a pair of spaced legs **226** and **227** through which passes the hinge pin **228** for the levers **230** and **231** and which also supports the torsion springs **232** and **233**. A resistor contact leaf spring **262** having a pair of spaced parallel legs **263** and **265** and a short central leg **264** is secured in a substantaially horizontal plane to an upper face on block **229** as by a screw **257**. Neither of the spring legs **263** or **265** contact the shorting rod when it is in its lowermost position and in engagement with central contacts **221** and **223**. On the underside of the block **229** a substantially U-shaped ground contact spring **259** is secured as by a screw **260** and has contacts **285** and **286** at the ends of its legs which protrude upwardly through openings **287** and **288** in jack barrels **218** and **219** respectively and into the pathway of the metallic tubes on patchcords or dummy plugs inserted into the left ends of the jack barrels. A balancing resistor, not shown, is mounted within the insulating block **229**. One lead thereof is soldered to the central leg **264** of the resistor contact spring **262** at **269** and the other lead is soldered at **270** to an integral projecting lug **271** on the ground contact spring **259**. In order to prevent grounding between the resistor contact spring **262** and the hinge pin **228** which are in close proximity, that portion of the hinge pin between the levers **230** and **231** is covered with a tube **272** of insulating material.

Upon full insertion of a patchcord or dummy plug into the left end of jack barrel **218** the corresponding end of the shorting rod **224** will be raised away from

the central conductor 221 and into contact with leg 263 on the resistor contact spring 262. This will ground the central conductor 223 in the other jack barrel 219 via the shorting rod 224, leg 263 and spring 262, the resistor, ground contact spring 259, contact 285, and the metallic tube on the patchcord in the jack barrel 18. The insertion of a patchcord in only the other jack barrel 219 will ground the central conductor 221 in the jack barrel 218 via the shorting rod, leg 265 on the resistor contact spring 262, the resistor, ground contact spring 259, contact 286 and the metallic tube on the patchcord in the jack barrel 18.

The presence of patchcords fully inserted into both jack barrels will raise the shorting rod out of engagement with both central conductors 221 and 223, and the closure of both cut away openings 240 and 241.

A metallic shielding enclosure 267 has openings 290 and 291 therethrough in FIGURES 10 and 11 to expose the internal parts to view for purposes of illustration.

The embodiment of FIGURES 12, 13 and 14 is similar in operation to the previously described embodiments except for the manner in which the "patched out" line is grounded and so only this mechanism will be described in detail. Jack barrels 318 and 319, metal bar 320, central conductors 321 and 323, shorting rod levers 330 and 331 and their torsion springs 332 and 333, and hinge pin 328 are similar to those in the previously described embodiments. Insulating block 329 has two upwardly extending outer legs 326 and 327 and two spaced inner legs 334 and 335, the hinge pin 328 passing through all four legs.

A shorting rod indicated generally at 324 is shown to enlarged scale in FIGURE 14. This shorting rod differs from those previously described in that it includes a balancing resistor 338 which is mounted within two similar metallic cups 339 and 340 that have their open ends facing each other and separated by a gap through which is visible the central portion of the insulating covering of the cylindrical shaped resistor 338. The two leads of the resistor are soldered to the cups 339 and 340 respectively, and the resistor is secured within the cups by a suitable cement to provide a rigid assembly. The shorting rod 324 is completed by oppositely extending coaxial metallic pins 341 and 342 which are preferably integral with the cups 339 and 340 to provide sufficient strength. It is loosely mounted in holes through the free end portions of the shorting rod levers 330 and 331 as in the previously described embodiments.

Mounted in a recess 343 on the underside of insulating block 329 by a screw 344 is a resistor shorting leaf spring 345 which is bifurcated to provide a pair of parallel legs 346 and 347 that extend to the right as viewed in FIGURE 13, to a point where they underlie the shorting rod 324. Their outer ends are turned upwardly to provide contacts 348 and 349 which resiliently engage the bottom side of the metallic cups 339 and 340 when the shorting rod is in engagement with both central conductors 321 and 323 as shown in the full lines in FIGURE 14. This is the condition of the jack when in its normal condition, without a patchcord or dummy plug inserted into the left end of either jack barrel 318 and 319. Central conductor 321 is connected to central conductor 323 via the shorting rod 324 and the resistor shorting leaf spring 345 which shorts out the resistor 338.

Mounted upon an upper surface of the insulating block 329 is a ground contact leaf spring 359 shown in FIGURE 12. It extends between the inner legs 334 and 335 of the insulating block and is held in place by the hinge pin 328 and by a metal lug 360 which is soldered or otherwise secured to the metal bar 320. Thus it is electrically connected to bar 320 by the lug 360 as well as by the hinge pin 328 and the coil springs 332 and 333. The right-hand portion of the spring 359 is bifurcated to provide legs 361 and 362 which overlie, but do not engage the metal cups 339 and 340 of the shorting rod 324 when the jack is in the normal condition as shown in full lines in FIGURE 14.

Now if a patchcord is inserted into the left end of jack barrel 318 it will raise the pin 341 (FIGURE 14) of the shorting rod to the position shown in dot-dash lines at 341*a*. The other pin 342 will remain in engagement with central conductor 323 which will now be grounded by way of pin 342, cup 340, resistor 338, cup 339, leg 361 of spring 359 and lug 360 (as well as hinge pin 328 and the torsion springs 332 and 333). It will be noted from FIGURE 14 that in this condition the spring leg 361 has been raised to the position 361*a* but that spring leg 362 remains undisturbed, and is not engaged by the metal cup 340 because if it were the resistor 338 would be by-passed. Also, the metal cups 339 and 340 are raised to a position out of engagement with the legs on the resistor shorting spring 345, the outer free end of which has risen substantially to the position shown in dot-dash lines at 345*a*.

As will be understood, if the patchcord had been inserted into the other jack barrel 319 the shorting rod 324 would be tilted in the reverse direction in FIGURE 14, and if patchcords are in place in both jack barrels then both sides of the shorting rod will be elevated and both sides of the resistor will be grounded.

In the embodiment of FIGURE 15 instead of a shorting rod as used in the previously described embodiments, a substantially V shaped shorting leaf spring indicated generally at 424 is used.

Jack barrels 418 and 419 are rigidly secured to a common metallic bar 420 and have central conductors 421 and 423 mounted therein centrally of insulators 422 and 425. Coaxial cables leading to a video or other radio frequency source and to a load are secured to the left ends of jack barrels 418 and 419 respectively, and the right ends are adapted for the insertion of patchcords or dummy plugs as in the previous embodiments. A metallic shielding enclosure 467 encloses the internal mechanism of the jack and has a tight fit over the bar 420 to hold it in place.

A block 429 of insulating material is mounted between the two jack barrels, being secured to bar 420 as by screws, not shown. The block has end portions 430 and 431 which are cut by the plane of the sectional view, and a recess 432 lying behind that plane. The V shaped spring 424 lies within this recess, against its planar surface, which is smooth so as to eliminate friction between the surface and the spring during movement of the latter. The right end of the spring 424 is formed into a partial circular loop 433 which fits within a mating semicircular recess 437 having a surface 438 coplanar with the surface of recess 432. In the position shown in FIGURE 15 the leg 439 and 440 of the shorting spring 424 are compressed toward each other from their unstressed positions, and their outer ends are in resilient engagement with the central conductors 421 and 423 respectively, thus electrically connecting the central conductors. An insulating pin 441 of nylon or the like, within the recess 437 limits sliding movement to the left of the spring loop 433 within the recess.

In order to increase the force of the resilient contact between the outer ends 439 and 444 of the shorting spring 424 against the central conductors 421 and 423 a helper leaf spring 444 may be used. This spring is slightly wider than the shorting spring, and is seated within a recess 445 that is slightly deeper than the recess 432. Spring 444 has legs 446 and 447 that bear against the inner surfaces of legs 439 and 440 of the shorting spring 424. At its left end the helped spring has a partially circular loop 448 which surrounds a pin 449 of nylon or the like that prevents movement of the helper spring to the right.

Protruding above the surface of the recess 432 in the insulating block 429 and into the plane of the shorting spring 424 is an elongated metallic contact block 453 which has a portion 454 that extends through the insulating block to the other side thereof where it is soldered

to one lead of a balancing resistor **455**, the other lead of which is grounded to the metallic bar **420** as indicated at **456**.

Jack barrels **418** and **419** are cut away to provide openings **458** and **459** that face each other and permit the legs **439** and **440** of the shorting spring to enter the barrels and engage the central conductors **421** and **423**. A pair of actuating levers **461** and **462** of insulating material also have their free ends protruding through the openings **458** and **459**, their other ends being hinged upon pins **463** and **464**.

The normal condition of the jack is as shown in FIGURE 15, with the central conductors **421** and **423** connected by the shorting leaf spring **424**. If now a patchcord is inserted into the right end of jack barrel **418** its metal outer tube will engage and turn the actuating lever **461** counterclockwise to its depressed position shown at **461***a*. When in this position the lever **461** has disengaged the leg **439** of the shorting spring from the central conductor **421** and forced it into resilient engagement with one end of the metallic contact block **453**. The leg **439** becomes slightly bowed when in this position, as shown in the dot-dash position at **439***a*, since the lever **461** engages the leg substantially at its mid-length.

In this condition a new load is connected to the jack barrel **418** and its central conductor **421**. The load connected to the left end of jack barrel **419** is now grounded, the central connector **423** being grounded via shorting spring leg **440**, loop **433**, leg **439**, contact block **453** and resistor **455**. As in the other embodiments a patchcord may also be inserted into the right end of the other jack barrel **419**, and if there is no patchcord in jack barrel **418** its central conductor will be grounded when the leg **440** of the shorting spring is engaged with the lower end of contact block **453**. Patchcords may be inserted into both jack barrels at the same time, in which case both of the legs **439** and **440** will be disengaged from their central conductors and will engage the opposite ends of the contact block **453**.

All of the illustrated embodiments of the invention are of simple rugged construction, leading to long life, ready assembly, and facilitating miniaturization.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

**1.** A self-normalling jack for selectively connecting a first coaxial cable to a second, or for disconnecting them, and also adapted to connect either of them to other coaxial cables when disconnected from each other, comprising,

(a) first and second jack barrels rigidly and electrically connected together, each having adjacent one end thereof a central conductor insulated from the barrel, but with exposed uninsulated portions within the barrel, the other ends of said jack barrels being open and the wall of each jack barrel having a transverse opening therethrough aligned with the exposed portion of said central conductors,

(b) a shorting rod extending transversely of said jack barrels, into said transverse openings therethrough and with its opposite ends engaging the exposed portions of said central conductors, thereby connecting them,

(c) resilient means urging said shorting rod into engagement with said central conductors,

(d) non-conductive means extending into said transverse opening in said jack barrels and into the path of a patchcord or dummy plug inserted into the open end of either barrel,

(e) said non-conductive means each being effective to separate one end of said shorting rod from its respective central conductor upon the insertion of a patchcord or dummy plug into the open end of its respective jack barrel,

(f) a normally electrically floating circuit impedance balancing element,

(g) and means operative to electrically connect said circuit impedance balancing element to said shorting rod and to said jack barrels upon separation of either end of said shorting rod from its respective central conductor.

**2.** In the jack described in claim **1**, said last named means comprising,

(a) a first contact engageable and moveable by said shorting rod in its separating movement away from either of said central conductors and a second contact operable by said first contact in its movement to make an electrical connection to said jack barrels,

(b) said circuit impedance balancing element being connected to said first and second contacts.

**3.** In the jack described in claim **1**,

(a) a hinge pin fixed with respect to said jack barrels,

(b) said non-conductive means being rotatably mounted upon said hinge pin,

(c) and said last named means comprising first and second contacts rotatably mounted upon said hinge pin for movement as a unit.

**4.** In the jack described in claim **1**,

(a) a hinge pin fixed with respect to said jack barrels,

(b) said non-conductive means being rotatably mounted upon said hinge pin,

(c) said last named means comprising first and second contacts rotatably mounted upon said hinge pins as a unit,

(d) and said impedance balancing element being connected with said first and second contacts and mounted for movement therewith.

**5.** In the jack described in claim **1**,

(a) a hinge pin fixed with respect to said jack barrels,

(b) said non-conductive means being rotatably mounted upon said hinge pin,

(c) an insulator block rotatably mounted upon said hinge pin,

(d) said last named means comprising a first contact engageable by said shorting rod in the movement of either end thereof away from its respective central conductor, and operable to rotate said insulator block,

(e) said last named means also including a second contact operable to connect electrically to said jack barrels upon rotation of said insulator block by said first contact,

(f) and said circuit impedance balancing element being mounted upon said insulator block and connected between said first and second contacts.

**6.** The jack described in claim **1**, wherein,

(a) said last named means comprises a first contact engageable by said shorting rod in its separating movement away from either of said central conductors and a pair of electrically connected second contacts each protruding into one of said jack barrels into the path of the external metal tube on a patchcord or dummy plug inserted into either barrel,

(b) and said circuit impedance balancing element being connected between said first and second contacts.

**7.** In the jack described in claim **6**, said shorting rod comprising a pair of spaced metallic cups with their open ends facing each other, a resistor fixedly seated within and electrically connected to said cups, and coaxial conductive pins protruding outwardly from the closed ends of said cups.

8. The jack described in claim 6, wherein,

(a) each jack barrel has a second opening through the wall thereof,

(b) and said second contacts protrude through said second openings into said jack barrels.

9. The jack described in claim 1 wherein said circuit impedance balancing element is a resistor.

10. A self-normalling jack for selectively connecting a first coaxial cable to a second, or for disconnecting them, and also adapted to connect either of them to other coaxial cables when disconnected from each other, comprising,

(a) first and second jack barrels rigidly and electrically connected together, each having adjacent one end thereof a central conductor insulated from the barrel, but with exposed uninsulated portions within the barrel, the other ends of said jack barrels being open and the wall of each jack barrel having a transverse opening therethrough aligned with the exposed portion of said central conductors,

(b) a shorting rod extending transversely of said jack barrels, into said transverse openings therethrough and with its opposite ends engaging the exposed portions of said central conductors, thereby connecting them,

(c) resilient means urging said shorting rod into engagement with said central conductors,

(d) non-conductive means extending into said transverse openings in said jack barrels and into the path of a patchcord or dummy plug inserted into the open end of either barrel,



(e) said non-conductive means each being effective to separate one end of said shorting rod from its respective central conductor upon the insertion of a patchcord or dummy plug into the open end of its respective jack barrel,

(f) said shorting rod comprising an assembly of a pair of conductors and a circuit impedance balancing resistor, said conductors being separated by and connected to the leads of said resistor,

(g) a resistor shorting contact effective to by-pass said resistor when said shorting rod conductors are in engagement with the exposed ends of said central conductors in said jack barrels, but ineffective when either shorting rod conductor is disengaged from its respective central conductor

(h) and contact means operable to electrically connect a disengaged shorting rod conductor to said jack barrels.

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