



# E & B Select Fire Side Port Tandem Sub Assembly

## MAN-30-XXX-0002-96

### Owen Oil Tools

5405 Blindman Crescent  
Red Deer County Alberta Canada T4S 2B3  
Phone: 1-403-340-1017  
Fax: 1-403-340-1415  
Toll Free: 1-888-345-1017  
[www.owentools.com](http://www.owentools.com)

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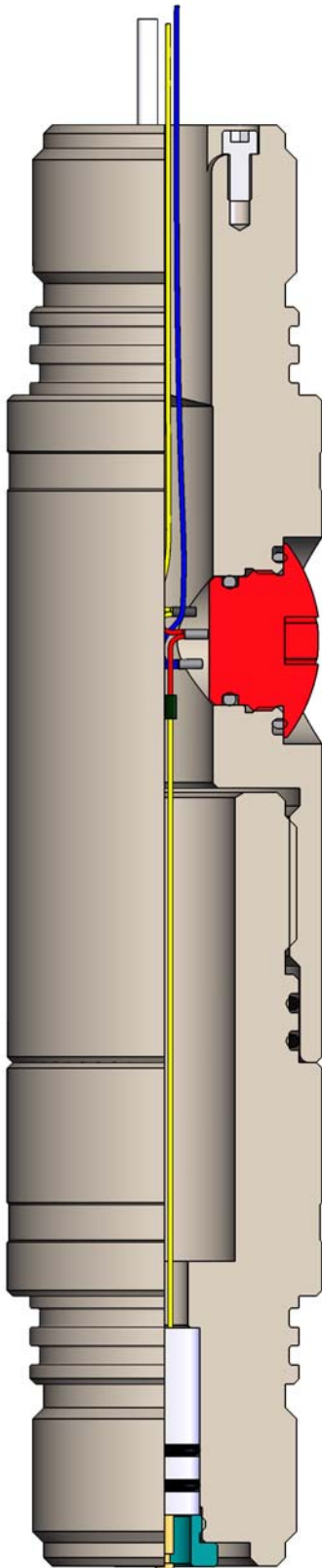
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### Description

The E & B Select Fire Side Port Tandem Sub Assembly is used in wireline applications where a string of two or more perforating guns are detonated independently of each other.

When the perforating gun is ready to be detonated, a DC current is applied which detonates the first or lowest gun in the string. The detonation from this gun activates the E & B switch for the next gun immediately above it. Applying an opposite polarity DC current will detonate the second gun and activate the E & B switch for the third gun. Alternating the polarity of DC current applied allows independent detonation of each perforating gun in the string.

### Features and Benefits

- Allows independent detonation of multiple perforating guns in a multi-gun string.
- Side port provides access to connect detonators and select fire switches.
- Increased internal space for detonators and wiring.
- Uses the same threads as standard tandem subs allowing for easy insertion into multi-gun strings.
- Available in 73mm (2-7/8"), 79mm (3-1/8"), 86mm (3-3/8"), 101mm (4") and 127mm (5") sizes

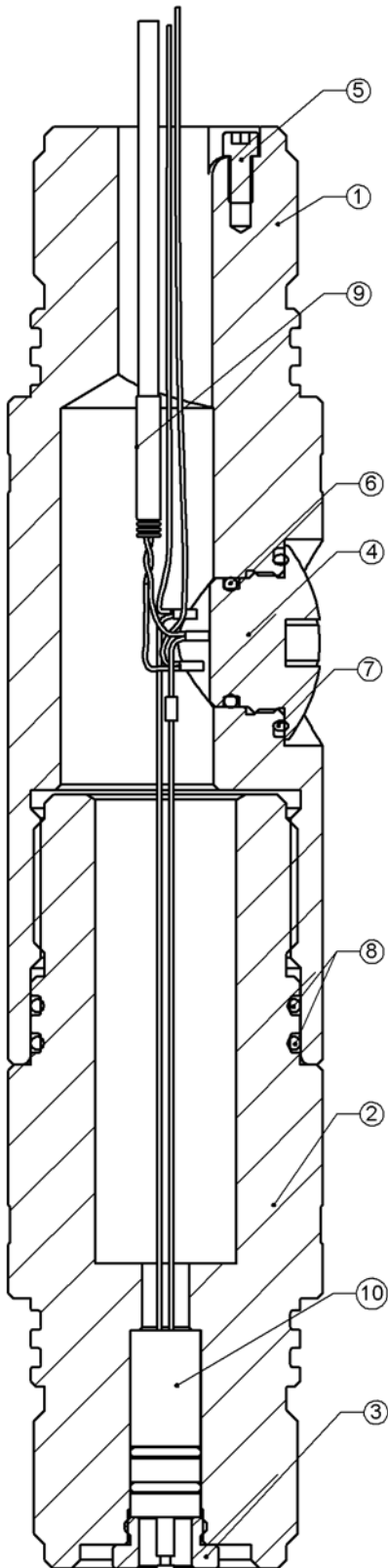
### Specifications

Size		Nominal OD		Pressure Rating
73 mm	2.875 in	79 mm	3.125 in	Same as Carrier
79 mm	3.125 in	79 mm	3.125 in	Same as Carrier
86 mm	3.375 in	86 mm	3.375 in	Same as Carrier
101 mm	4.000 in	101 mm	4.000 in	Same as Carrier
127 mm	5.000 in	127 mm	5.000 in	Same as Carrier

**Side Port Cap Recommended Torque 60 ft·lbs (81 N·m)**

E & B Select Fire Side Port  
Tandem Sub Assembly

MAN-30-XXX-0002-96



Item	Part Number	Qty	Description
--	<b>30-073-0002-96</b>	--	<b>73mm E&amp;B Select Fire Side Port Arming &amp; Switch Tandem Sub Assembly</b>
1	30-073-0002-11	1	E&B Select Fire Arming Sub
2	30-073-0002-12	1	E&B Select Fire Switch Sub
3	30-000-0024-00	1	E&B Retainer Nut
4	WT-401-0007-000	1	Top Fire Sub Cap, 1/2" Ratchet
5	PF-020-025F-050SS	1	Cap Screw SO 1/4" - 28 UNF x 1/2" Lg., Stainless
6	OOO-N569-216	1	O-Ring 90 Durometer Nitrile
*7	OOO-N569-224	1	O-Ring 90 Durometer Nitrile
8	OOO-N569-228	2	O-Ring 90 Durometer Nitrile
9	(A) Reference	1	DET-0000-010L, DET-3050-084 or DET-3051-021
10	(A) (B) Reference	1	E&B Switch

Item	Part Number	Qty	Description
--	<b>30-079-0002-96</b>	--	<b>79mm E&amp;B Select Fire Side Port Arming &amp; Switch Tandem Sub Assembly</b>
1	30-079-0002-12	1	E&B Select Fire Arming Sub
2	30-079-0002-13	1	E&B Select Fire Switch Sub
3	30-000-0024-00	1	E&B Retainer Nut
4	WT-401-0007-000	1	Top Fire Sub Cap, 1/2" Ratchet
5	PF-020-025F-050SS	1	Cap Screw SO 1/4" - 28 UNF x 1/2" Lg., Stainless
6	OOO-N569-216	1	O-Ring 90 Durometer Nitrile
*7	OOO-N569-224	1	O-Ring 90 Durometer Nitrile
8	OOO-N569-230	2	O-Ring 90 Durometer Nitrile
9	(A) Reference	1	DET-0000-010L, DET-3050-084 or DET-3051-021
10	(A) (B) Reference	1	E&B Switch

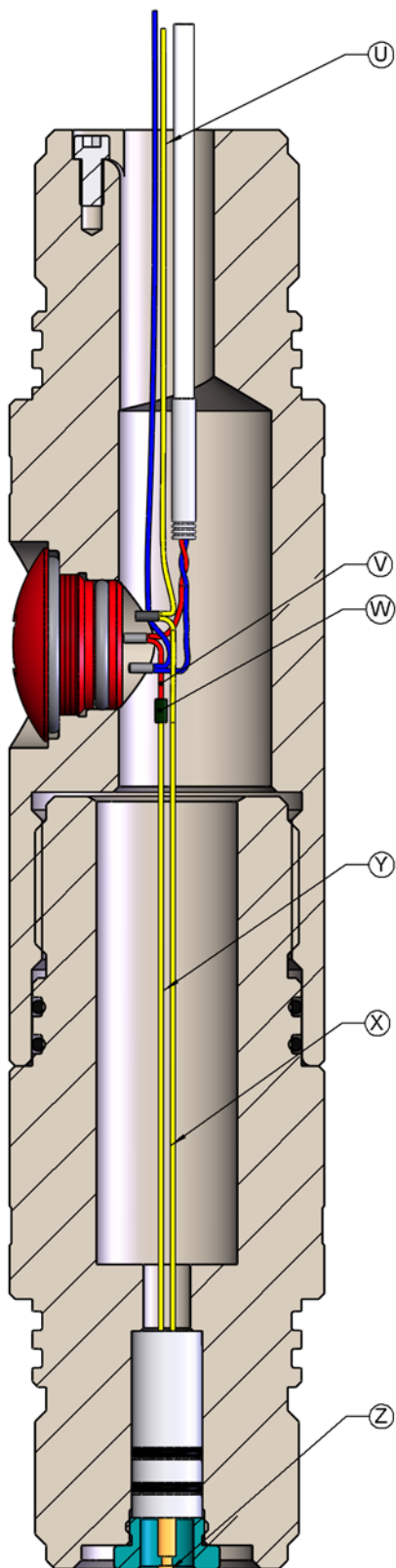
Item	Part Number	Qty	Description
--	<b>30-086-0002-96</b>	--	<b>86mm E&amp;B Select Fire Side Port Arming &amp; Switch Tandem Sub Assembly</b>
1	30-086-0002-12	1	E&B Select Fire Arming Sub
2	30-086-0002-13	1	E&B Select Fire Switch Sub
3	30-000-0024-00	1	E&B Retainer Nut
4	WT-401-0007-000	1	Top Fire Sub Cap, 1/2" Ratchet
5	PF-020-025F-050SS	1	Cap Screw SO 1/4" - 28 UNF x 1/2" Lg., Stainless
6	OOO-N569-216	1	O-Ring 90 Durometer Nitrile
*7	OOO-N569-224	1	O-Ring 90 Durometer Nitrile
8	OOO-N569-231	2	O-Ring 90 Durometer Nitrile
9	(A) Reference	1	DET-0000-010L, DET-3050-084 or DET-3051-021
10	(A) (B) Reference	1	E&B Switch

Item	Part Number	Qty	Description
--	<b>30-101-0002-96</b>	--	<b>101mm E&amp;B Select Fire Side Port Arming &amp; Switch Tandem Sub Assembly</b>
1	30-101-0002-13	1	E&B Select Fire Arming Sub
2	30-101-0002-14	1	E&B Select Fire Switch Sub
3	30-000-0024-00	1	E&B Retainer Nut
4	WT-401-0007-000	1	Top Fire Sub Cap, 1/2" Ratchet
5	PF-020-025F-050SS	1	Cap Screw SO 1/4" - 28 UNF x 1/2" Lg., Stainless
6	OOO-N569-216	1	O-Ring 90 Durometer Nitrile
*7	OOO-N569-224	1	O-Ring 90 Durometer Nitrile
8	OOO-N569-236	2	O-Ring 90 Durometer Nitrile
9	(A) Reference	1	DET-0000-010L, DET-3050-084 or DET-3051-021
10	(A) (B) Reference	1	E&B Switch

Item	Part Number	Qty	Description
--	<b>30-127-0002-96</b>	--	<b>127mm E&amp;B Select Fire Side Port Arming &amp; Switch Tandem Sub Assembly</b>
1	30-127-0002-11	1	E&B Select Fire Arming Sub
2	30-127-0002-12	1	E&B Select Fire Switch Sub
3	30-000-0024-00	1	E&B Retainer Nut
4	WT-401-0007-000	1	Top Fire Sub Cap, 1/2" Ratchet
5	PF-020-025F-050SS	1	Cap Screw SO 1/4" - 28 UNF x 1/2" Lg., Stainless
6	OOO-N569-216	1	O-Ring 90 Durometer Nitrile
*7	OOO-N569-224	1	O-Ring 90 Durometer Nitrile
8	OOO-N569-346	2	O-Ring 90 Durometer Nitrile
9	(A) Reference	1	DET-0000-010L, DET-3050-084 or DET-3051-021
10	(A) (B) Reference	1	E&B Switch



E & B Select Fire Switch Functionality



Until the E & B Switch is activated, any current applied to the yellow wire (item X) will flow through the switch to the pin (item Z). In this state, there is an open circuit between the two yellow wires going into the switch (items X & Y), therefore, no current will pass through the detonator. When the gun directly below the sub is fired, the pressure and velocity from the detonation forces the pin (item Z) up into the switch closing the circuit between the two yellow wires (items X & Y). The diode (item W) allows current to pass through it in one direction only. In the P-100ST, the diode allows positive current to flow from the yellow wire to the red wire, whereas in the N-100ST the diode allows negative current to flow from the yellow wire to the black\* wire. To fire a gun equipped with an activated P-100ST switch, a positive DC (direct current) must be applied. **However, applying an AC (alternating current) will fire all guns in rapid succession.**

The first or bottom gun must be fired with the opposite polarity as the switch above it or the bottom two guns will fire in rapid succession. We recommend you follow the **O-P-E-N (Odd-Positive-Even-Negative)** practice preached in select-fire operations for wireline. Following this practice will result in using an N-100ST E & B Switch in the lowest E & B Tandem Sub, thus allowing you to fire the bottom (or first) gun with a positive DC current and then the second gun with a negative DC current. Every switch in a string must have the opposite polarity of the switch above and below it, as any two switches next to each other with the same polarity will both fire in rapid succession.

\*To distinguish the polarity of the switches, the P-100ST (positive DC current) uses a red wire for item V and the N-100ST (negative DC current) uses a black wire for item W.

### E & B Select Fire Switch Installation

Begin loading by inspecting the E & B Select Fire Switch Sub (item 2) bores. The switch bore should be free of debris. Check passage for wires as well. The switch (item 10) should fit freely into the bore up to the O-rings.

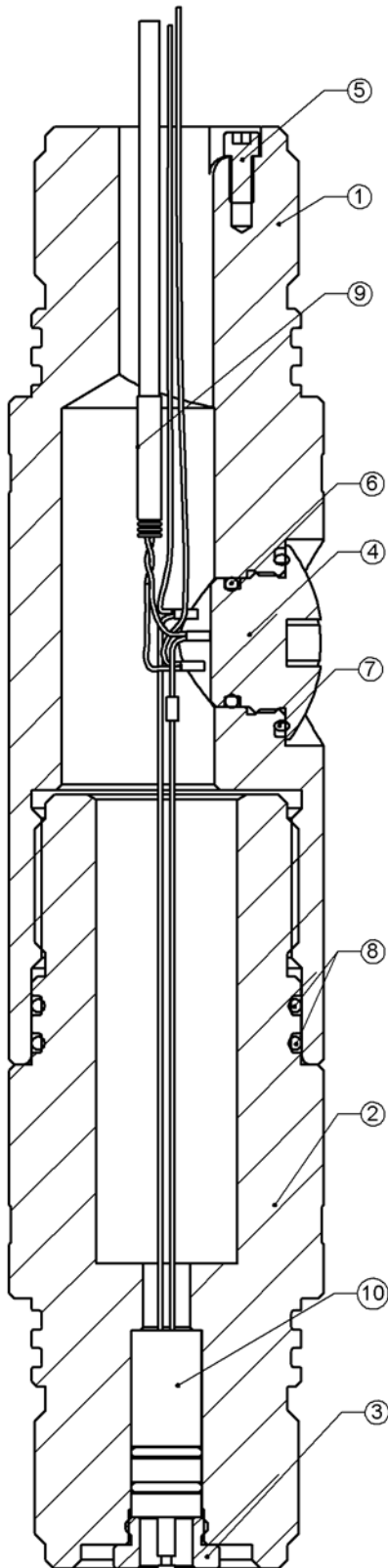
If not already assembled, grease the two O-rings (item 8) and install them onto the switch sub (item 2), then screw the arming sub onto the switch sub and shoulder them out.

Unwind switch wires and feed them through the sub assembly. While holding slight tension on the wires to prevent slack, insert the switch body up to the O-rings. A light coat of grease on the body and O-rings will help sealing and switch removal. Gently push or tap the switch body into bore.

**Do Not** hit or press on the brass pin. This will activate the switch (close circuit between the two yellow wires).

Ensure that the switch wires do not become pinched behind the switch body. Install the retainer (item 3), to seat the switch fully into the bore. Pinched or twisted wires are the most common cause of problems.

Pull the free ends of the wires out through the side port of the arming sub.





## Wiring Instructions for Multigun Strings

Read all instructions carefully before beginning assembly of carriers. Steps 1 to 21 can be done in the shop. Arming of the carrier must be done at the well site.

### Load Carrier

1. Load charges and detonating cord in the carriers to be used as per standard procedure. Ensure that enough detonating cord is run to allow it to extend down through the top bore of the E & B Arming Sub (E & B Select Fire Side Port Arming Sub) and out the side port.
2. Run one yellow wire down through the middle of each gun with enough slack to allow it to extend down through the top bore of the E & B arming sub and out the side port. Note the top carrier will need to have a longer wire as this wire must extend up through the top sub and make the connection with the cable head.
3. Ground one blue wire to the bottom end of the charge tube in each carrier (except the bottom carrier) and allow enough length for it to extend down through the top bore of the E & B arming sub and out the side port.

### String Assembly

#### Top Carriers

4. Starting at the top carrier feed the top end of the yellow wire sticking out of the carrier up through the top sub.
5. Screw the top sub into the top carrier ensuring the yellow wire does not twist up in the top sub bore.
6. Connect the yellow wire to the wireline top sub electrical connection assembly.
7. Feed the yellow wire, blue wire and detonating cord coming out of the bottom of the carrier through the top bore of the E & B arming sub and out the side port. If you are running an even number of carriers then the top E & B switch sub should have a negative E & B switch (N-100ST). If you are running an odd number of carriers then the top E & B switch sub should have a positive E & B switch (P-100ST). This will ensure the lowest switch is an N-100ST.
8. Screw the E & B arming and switch sub assembly into the bottom of the carrier ensuring the yellow wire, blue wire and detonating cord do not bind in the bore of the arming sub.
9. Connect the yellow wire from the previous step to the plain yellow wire from the E & B switch and leave them sticking out of the side port.

#### Intermediate Carriers

10. Remove the E & B switch retainer nut from the E & B switch sub previously installed and slide it onto the yellow wire from the top of the next carrier.
11. Wrap this yellow wire around the pin on the E & B switch sticking out of the bottom of the E & B switch sub from the previous step and secure with tape.
12. Re-install the E & B switch retainer nut that was removed in Step 10.
13. Screw this carrier onto the bottom of the E & B switch sub from the previous step ensuring that the wire does not bind in the carrier.
14. Feed the yellow wire, blue wire and detonating cord coming out of the bottom of the carrier through the top bore of the next E & B tandem sub and out the side port. Use a tandem sub with the opposite polarity E & B switch as the E & B switch directly above it in the string. **If this instruction is not followed, both carriers will fire in rapid succession when the lower of these two carriers is fired.**
15. Screw the E & B arming and switch sub assembly into the bottom of the carrier ensuring the yellow wire, blue wire and detonating cord do not bind in the bore of the arming sub.
16. Connect the yellow wire from the previous step to the plain yellow wire from the E & B switch and leave them sticking out of the side port.
17. Repeat Steps 10 to 16 for additional intermediate carriers.



### Bottom Carrier

18. Remove the E & B switch retainer nut from the E & B switch sub from the previous step and slide it onto the yellow wire from the top of the next carrier.
19. Wrap this yellow wire around the pin on the E & B switch sticking out of the bottom of the E & B switch sub from the previous step and secure with tape.
20. Re-install the E & B switch retainer nut that was removed in Step 18.
21. Screw this carrier onto the bottom of the E & B switch sub from the previous step ensuring that the wire does not bind in the carrier.

### Arm Carrier

The following steps must be done at the well site.

### Bottom Carrier

22. Follow company procedure for checking fire.
23. Use standard procedure to connect the detonator electrically before ballistically, such as the following:
24. Insert the detonator into a safety chamber prior to wiring.
25. Ground one wire from the detonator to the charge tube.
26. Connect the other wire from the detonator to the yellow wire sticking out of the bottom of the carrier.
27. Remove detonator from the safety chamber.
28. Connect detonator to the end of the detonating cord sticking out the bottom of the carrier. See instructions for model of detonator used.
29. Insert the detonator, wires and detonating cord into the bottom of the charge tube.
30. Screw the bottom sub onto the bottom of the carrier.

### Intermediate Carriers

31. Start at the lowest carrier and work your way up completing the following steps for each carrier.
32. Use standard procedure to connect the detonator electrically before ballistically, such as the following.
33. Insert the detonator into a safety chamber prior to wiring.
34. Connect one wire from the detonator to the blue wire sticking out of the side port of the E & B arming sub.
35. Connect the other wire from the detonator to the red (P-100ST E & B switch) or black (N-100ST E & B switch) wire sticking out of the side port of the E & B arming sub.
36. Remove detonator from the safety chamber.
37. Connect detonator to the end of the detonating cord sticking out of the side port of the E & B arming sub. See instructions for model of detonator used.
38. Insert the detonator, detonating cord and wires into the side port of the E & B arming sub and install the side port sub cap. Ensure wires do not get caught in the side port cap threads.
39. Repeat steps 32 to 38 for all remaining E & B arming and switch sub assemblies.

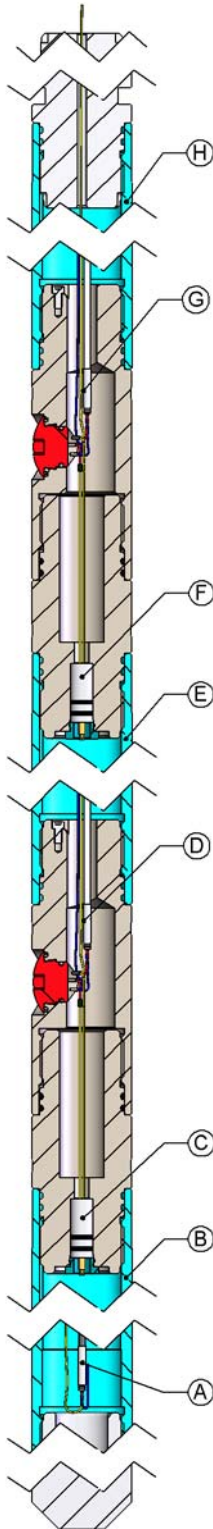
**The multigun string of carriers is now ready to be run down hole and fired. NOTE: the first (bottom) carrier will fire with a positive DC current. Each subsequent carrier will fire with an opposite polarity DC charge as the previous one.**





### Sequence of Events for Three Gun String Firing

In this example gun, two E & B switches are used in a three gun string to enable select firing of each gun. The bottom switch (C) is an N-100ST and the top switch (F) is a P-100ST. Since the bottom switch will pass a negative DC current to Detonator (D) when it is activated, the bottom gun (B) must be fired with a positive DC current.



1. The Gun String is placed at the correct depth and the operator applies a positive DC current at the shooting panel to fire the first (bottom) gun.
2. The current flows through the bottom detonator (A), the bottom gun (B) fires and as a result the pin on the first switch (C) is pushed up which activates the switch. As the diode on the first switch (C) blocks positive DC current, current does not reach the detonator (D) and the second gun (E) does not fire at this time.
3. When the operator is ready to fire the second gun (E) a negative DC current must be applied at the shooting panel.
4. The negative DC current is allowed to pass through the diode on the switch (C) and the detonator (D) detonates which fires the second gun (E). As a result, the pin on the second switch (F) is pushed up, this activates the switch. The diode on the second switch (F) blocks negative DC current, therefore current does not reach the detonator (G) and the third gun (H) does not fire at this time.
5. When the operator is ready to fire the third gun (H) a positive DC current must be applied at the shooting panel.
6. The positive DC current is allowed to pass through the diode on the switch (F) and the detonator (G) detonates which fires the third and last gun (H).