EXPERIMENTAL HOSE COUPLING DEVICES

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Forestry fire hose accounts for a large portion of the capital investment in forest fire suppression equipment in Canada. The normal complement of hose used with a portable fire pump exceeds the value of the pump. It is not uncommon to find several miles of hose in use on a single fire.

Thus, it is common practice to conserve hose and salvage damaged lengths whenever possible. There are several methods of patching hose but frequently a damaged section will be cut out and new couplings installed to make two short lengths from one damaged length. If the leak is near one end of a length of hose the coupling is removed, the damaged end cut off and the coupling re-installed.

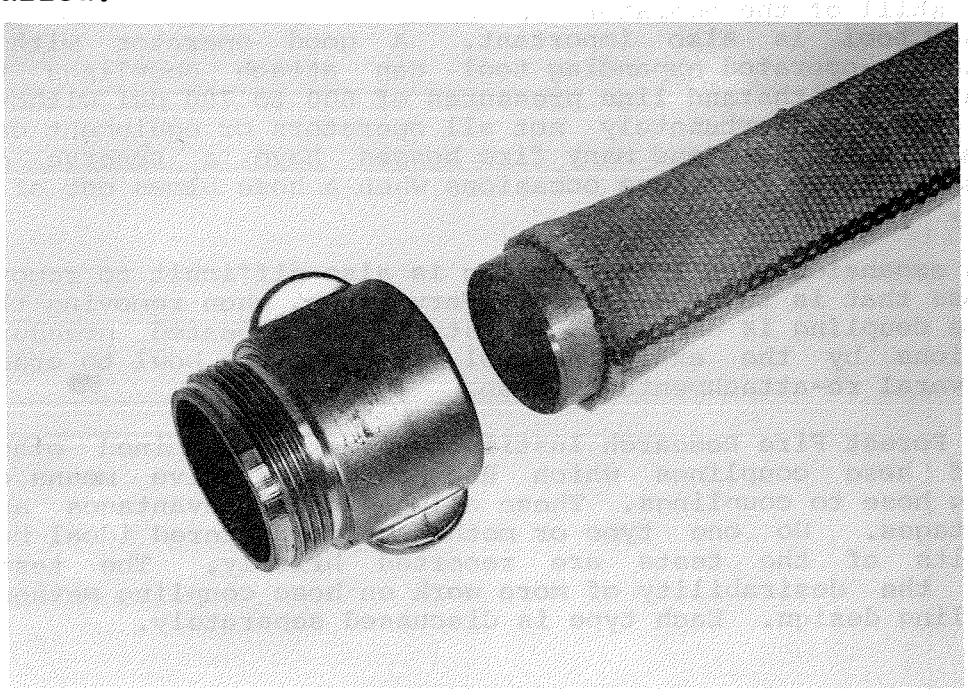

Photo 1. Expansion Ring Method

The brass expansion ring may be seen protruding from the end of the hose. In actual practice this is inserted flush with the end of the hose. The hose and ring are then inserted into the "bowl" at the back of the coupling.

The standard method of attaching hose couplings in most Canadian forest fire depots is to use what is known as an expansion ring. This is shown in Photo 1. The small ductile brass ring is slipped inside the end of a section of hose. The hose is then inserted into the "bowl" of the coupling and a special tool used to expand the brass ring. This forces the hose fabric into close contact with serrations or ribs on the inside of the hose coupling and holds it firmly.

If properly done, this forms a tight connection between hose and coupling that will withstand the effects of water pressure in the hose line. Naturally the quality of the brass expansion ring and the hose coupling are critical. The ring must expand evenly in all directions and set firmly inside the coupling. The coupling must be able to withstand this internal pressure without stretching out of shape. This is particularly important on the female coupling with its swivel ring. Undue expansion of the hose bowl section may lock the ring and prevent it from turning, making the coupling useless.

The skill of the operator in applying pressure with the expanding tool is also important. A good operator with a hydraulically-operated expanding tool can attach couplings to hose that will withstand line pressures of 600 to 700 psi without blowing off. Unfortunately not all operators or equipment can approach this standard and many fire bosses have a reserve of colourful language for those occasions when a hose blows out of a coupling.

The expansion-ring type coupling is also difficult to remove from hose that is to be salvaged. Very often, when removing the ring, the coupling is damaged. The strain of repeated pressure applications by the expanding tool may cause the bowl to crack after several re-attachments to hose.

The Forest Fire Research Institute recently examined other types of hose couplings which use an alternative means of attaching hose to couplings. These all had some advantages and disadvantages. No one type or method was considered ideal but the results of the tests are reported briefly. The tests indicate the desirability of more work on hose coupling methods and coupling design. Each type is discussed separately.

Shank Type Couplings

Both long and short shank couplings were tested, Photos 2 and 3. These couplings have standard threads and dimensions which comply with CSA B-89, the standard covering 1-1/2" forestry hose couplings. Thus, they can be used to connect to hose equipped with regular couplings. The shank is ribbed to provide a firm grip on the hose.

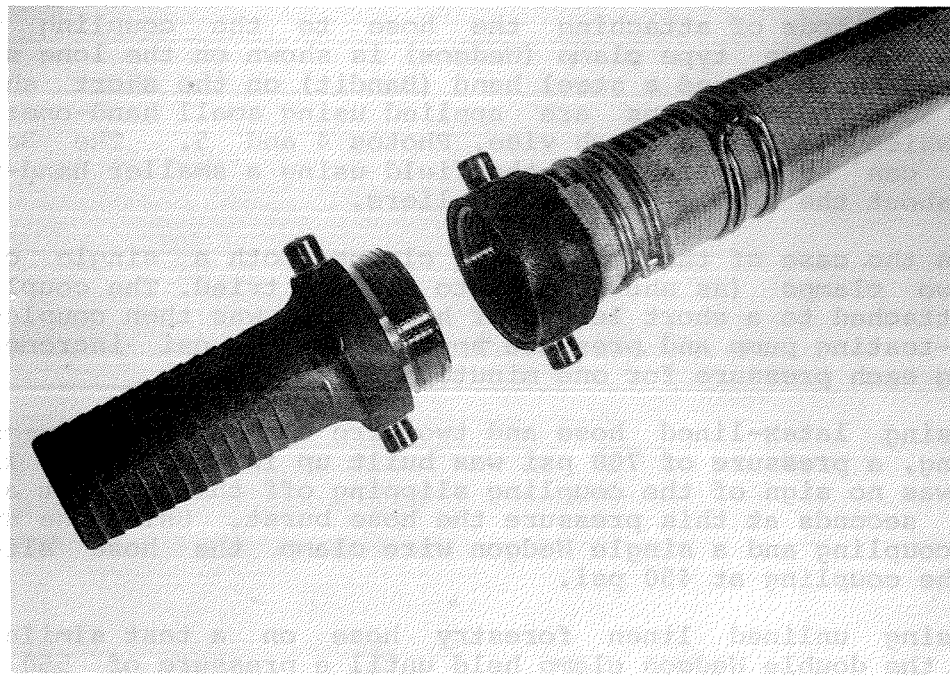

Photo 2. Long Shank Brass Coupling

The hose is attached to the female coupling on the right by two Wedgon clamps. These pre-formed wire loops are slipped over the hose, the free ends of the wire are drawn up tight with the clamping tool and bent over to lock the loop in place as shown.

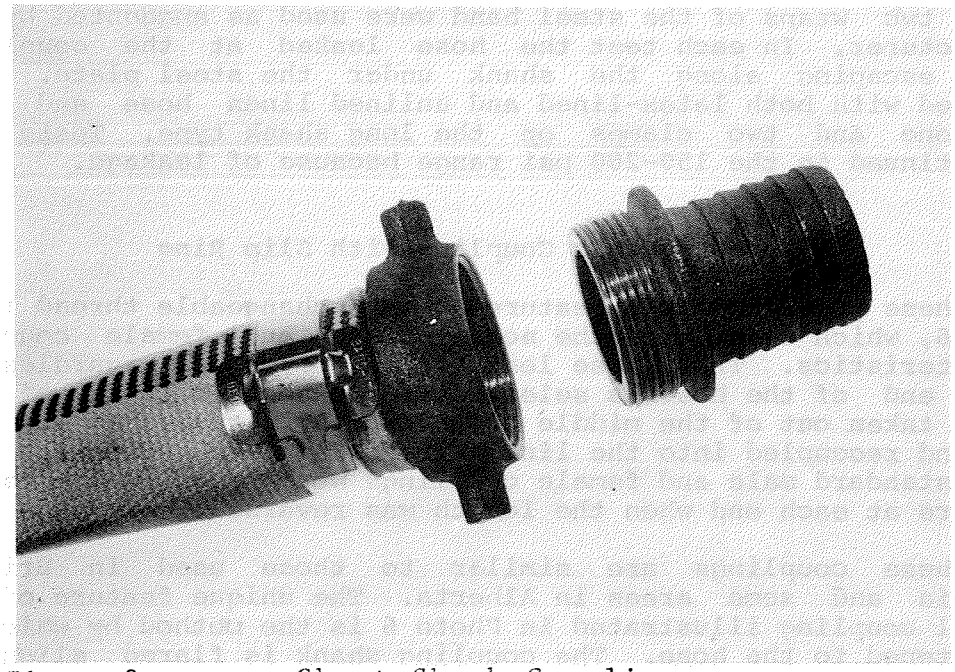

Photo 3. Short Shank Coupling

The hose has been attached to the female section of the coupling using a Bandit clamp. The stainless steel strapping or band is wrapped around the hose, drawn tight through the buckle with a clamping tool and the end bent over as shown to lock it in place.

Two methods of attaching the hose to the coupling were tested. A wire type clamp (Wedgon) is shown on the long shank coupling, Photo 2, and a steel band (Bandit) on the short shank, Photo 3. These clamps are applied using small hand-operated tools which clamp in a bench vise, Photos 4 and 5. The Bandit clamps can be applied in the field using a smaller hand-held tool, about the size of a pair of pliers.

In the case of the Wedgon wire clamps, both a single clamp and two clamps (as shown in Photo 2) were tried. The couplings were attached to a short length of hose, this was then coupled to a hose-testing pump and pressure applied in 50 psi increments, holding each pressure for one minute.

Using latex-lined hose and two wire clamps on a long-shank coupling, a pressure of 700 psi was built up in the hose line. There was no sign of the coupling slipping off the hose but after a few seconds at this pressure the hose burst. Using the short shank coupling and a single Wedgon wire clamp the hose slipped from the coupling at 450 psi.

Using unlined linen forestry hose on a test similar to above, the double Wedgon clamp held until a pressure of 550 psi was reached, the single clamp let the hose slip at 500 psi. In both cases there was leakage around the coupling before the hose let go.

The steel band (Bandit) clamps were less satisfactory. The use of a small steel plate as the clamping device, see Photo 3, made it difficult to clamp the hose tightly to the complete circumference of the coupling shank. This trouble existed even where two wraps of the steel band were used as suggested by the manufacturer. In each test the hose leaked at the coupling, water escaping along the shank under the steel plate. This occurred with both latex-lined and unlined linen hose and with both one and two clamps on the long shank type. Tests were discontinued in the 150-200 psi range because of leakage.

Interchangeable Coupling with Slip Ring

These hose couplings feature an interchangeable thread lock, Photo 6, which eliminates the normal male and female coupling characteristics. Thus, hose lengths can be coupled regardless of which end of the hose is selected, for example a length of hose can be taken out of the middle of a hose lay, reversed end for end and recoupled into the line. To do the same thing with hose using standard male and female couplings would require the use of adapters at each end when the length was reversed.

These couplings are similar to those used in British Columbia and some areas in Alberta. The unique feature of the Goodall coupling illustrated in Photo 6 is the method by which it is fastened to the hose. The coupling shank is flared slightly.

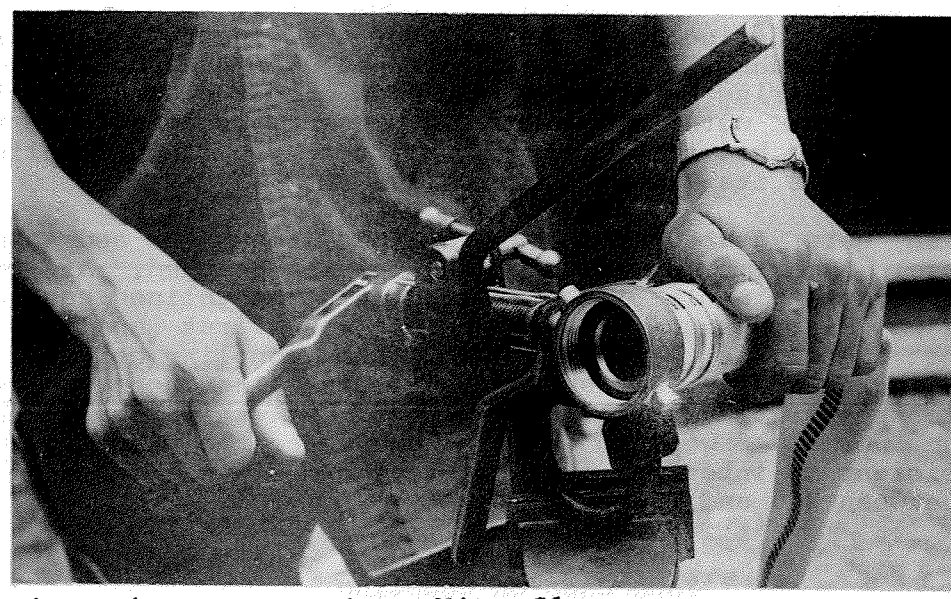

Photo 4. Wedgon Wire Clamp

The free ends of the pre-formed wire loop are being drawn back with the ratchet handle on the left. When tightened they are bent over and locked in place by means of the long curved bar at the top of picture. The free end of the wire is then trimmed off by the short cutter-bar which may be seen just to the left of the coupling.

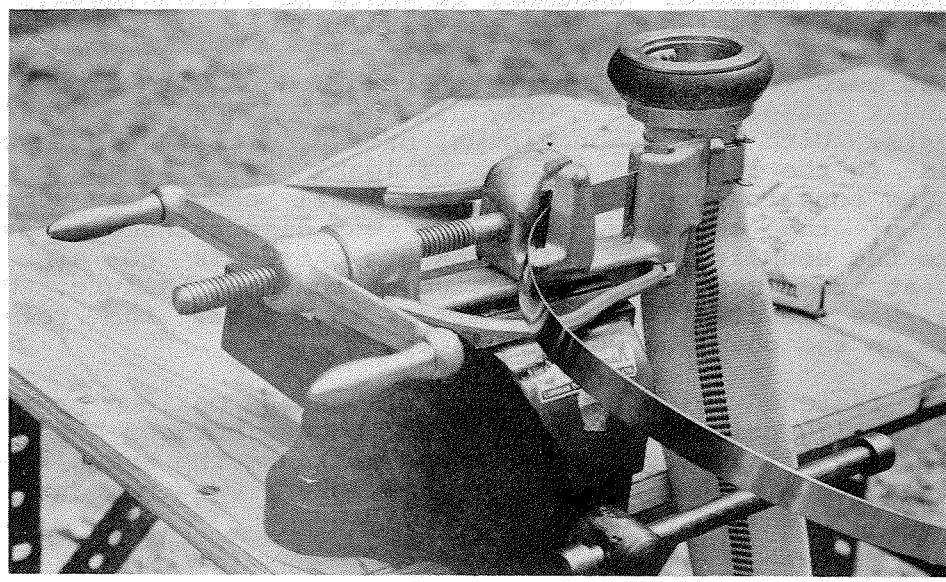

Photo 5. Bandit Steel Clamp

Steel strapping from the box in the background is wrapped around the hose and the buckle plate put in place. The strapping is pulled tight by turning the crank at the left. The curved horizontal bar at the base of the tool is used to cut off the steel strap and bend it over the buckle.

A small threaded ring fits loosely over the constricted portion of the coupling shank. The hose is slipped over the shank, under the ring and the ring twisted lightly down onto the hose forcing it into contact with the shank. As pressure is applied to the line and the hose has a tendency to pull away from the coupling, the ring tightens its grip automatically.

These were tested using both unlined linen hose and latex-lined hose. A maximum pressure of 800 psi was reached. At this point numerous "pinhole" leaks developed in the unlined hose and the test was discontinued. When pressure was first applied to the line there was leakage around the coupling collar. As pressure increased the leaking stopped on the lined hose. A very slight leak persisted on the unlined hose but this could have been the normal "sweating" of the hose under the ring. It was not sufficient to interfere with the test and did not increase in amount between 200 and 800 psi.

Yone Snap-on Coupling

These couplings, Photo 7, are manufactured in Japan. They are designed for operating pressures in the 150 psi range. They are extremely light in weight and snap together readily. A slight pressure on a sliding ring releases the coupling and allows the hose to be disconnected. They were fitted with a shank for attaching the hose but are available with an expansion ring bowl. These couplings have a soft rubber protective ring around the circumference of the female section. This cushions the coupling if dropped. However, it would be a disadvantage if the hose was laid inside or near the fire edge.

These were fastened to hose with both Wedgon wire clamps and with Bandit steel bands. Only latex-lined hose was used for these tests. With the Wedgon clamps, pressures of 400 psi were developed in the line with no sign of leakage or slipping of the hose at the coupling. Since this was well above the design pressure of the coupling the test was discontinued to avoid damage to the coupling. At this pressure there was no sign of leakage at the coupling or no sign of imminent failure. When pressure was lowered to zero after the test, the release mechanism on the coupling worked easily.

When fastened with Bandit hose clamps the maximum pressure attained was 170 psi. There was marked leakage between hose and coupling. The alloy used for these was soft and the shank tended to flatten under the buckle of the clamp when pressure was applied to tighten the band.

Barway Coupling

A companion series of tests was made with the Barway patent coupling. These were threaded to conform with CSA B-89 1-1/2" forestry coupling. They are designed for re-use and use a threaded expander shank which is screwed into the inside of the

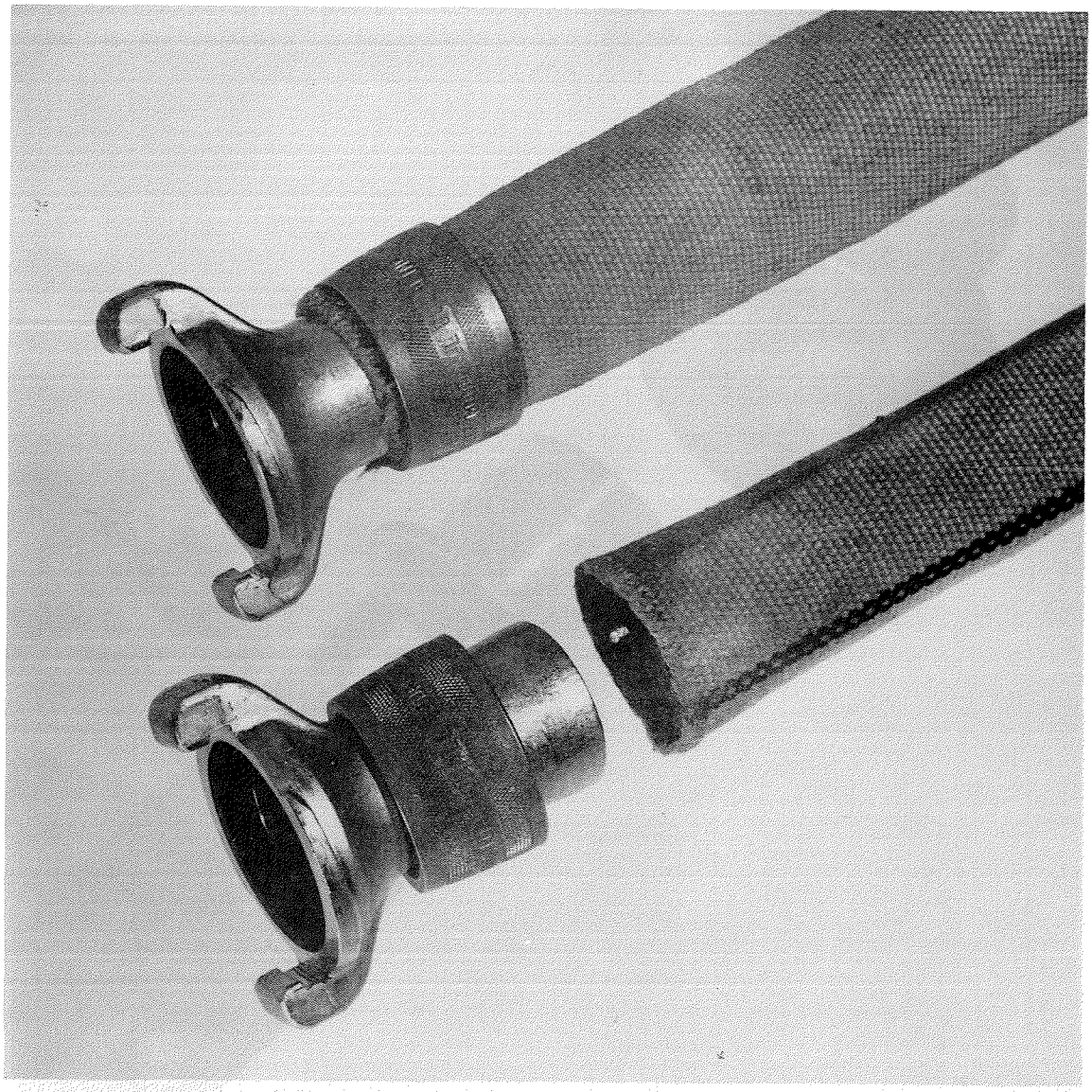

Photo 6. Interchangeable Couplings

These have both male and female threading on each coupling. They are locked by a quarter turn which pulls the two sealing rings or gaskets in the centre into close contact. The shank of the coupling has a slight taper from the back, or right end in the picture, to the front. The knurled ring is a loose fit over the constricted portion of the coupling and is tapered to match the shank. This ring is threaded on the inside. The hose is slipped over the shank and under the ring as shown at the top of the picture. Once pressure is applied to the line the ring is forced up onto the taper and holds the hose firmly yet permits easy removal at any time, by twising the ring back.

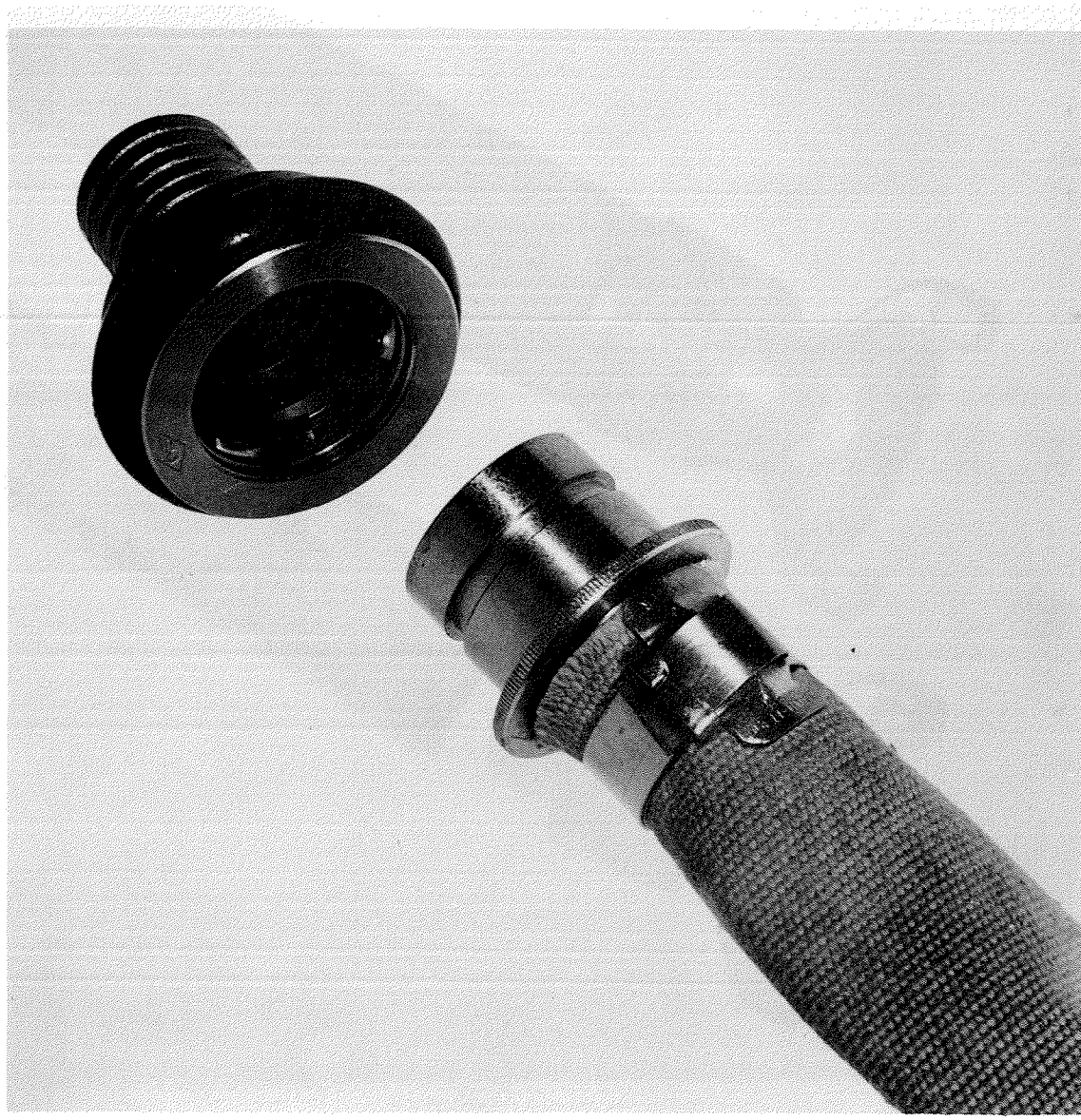

Photo 7. The Yone Snap-On Coupling

These lightweight couplings are carefully machined to provide a leakproof connection when the two sections are pressed together. Small spring-loaded projections in the female coupling engage in the groove which can be seen on the male end. The soft rubber ring on the outside of the female coupling protects the mechanism if the coupling is dropped and prevents accidental release. The couplings are disconnected by slight forward pressure on the knurled ring which may be seen at the hose end of the male coupling.

hose forcing it into close contact with the coupling bowl. The coupling process can be done in the field using a vise or clamp to hold the coupling and a special wrench and mandrel supplied by the manufacturer. A special lubricant is supplied for use when inserting the shank into the hose. These couplings are very well made in a lightweight alloy but the cost per set in small quantities is greater than a 100-foot length of hose.

The couplings used were designed specifically for latex-lined hose, although Barway couplings are available for unlined hose. (The couplings are designed to close tolerances and must be ordered for the specific type and diameter of hose to be used.) Pressures of up to 800 psi were developed in the test length with only slight leakage developing around the coupling in one case.

A second test was made with wet unlined linen hose to simulate re-coupling damaged hose under field conditions using Barway couplings. The hose slipped from the coupling when a pressure of 150 psi was developed in the line. This is not particularly significant since the couplings used, as mentioned above, were for use with latex-lined hose, and this may have been partly responsible for the disappointing performance. They have since been used with unlined hose, attached to dry hose, with excellent results at pressures up to 300 psi.

Future Work

The ease of attaching hose to a shank-type coupling, especially with a wire type clamp under field conditions is encouraging. This type of coupling can be re-used indefinitely and requires less operator skill when attaching hose than the expansion ring type.

The shank-type couplings used in this test were produced from cast brass and were heavier than the normal coupling. The long shank, while providing an excellent base for attaching to hose, is bulky when the hose is folded or rolled. The ribs on the shank made it difficult to slide latex-lined hose over both long and short shanks. This difficulty could be easily overcome by a slight reduction in overall diameter. The unlined hose could be slipped onto the shank without trouble.

Because of the success of these preliminary trials more work will be done on the design of lighter weight shank-type couplings and different shank patterns for use with the wire Wedgon clamps. Further tests on the Goodall slip-ring type coupling appear warranted. A similar but double slip-ring device is also available from the firm for repairing breaks in the middle of a length of hose. This was not available at the time the tests were made but will be tested in the future.