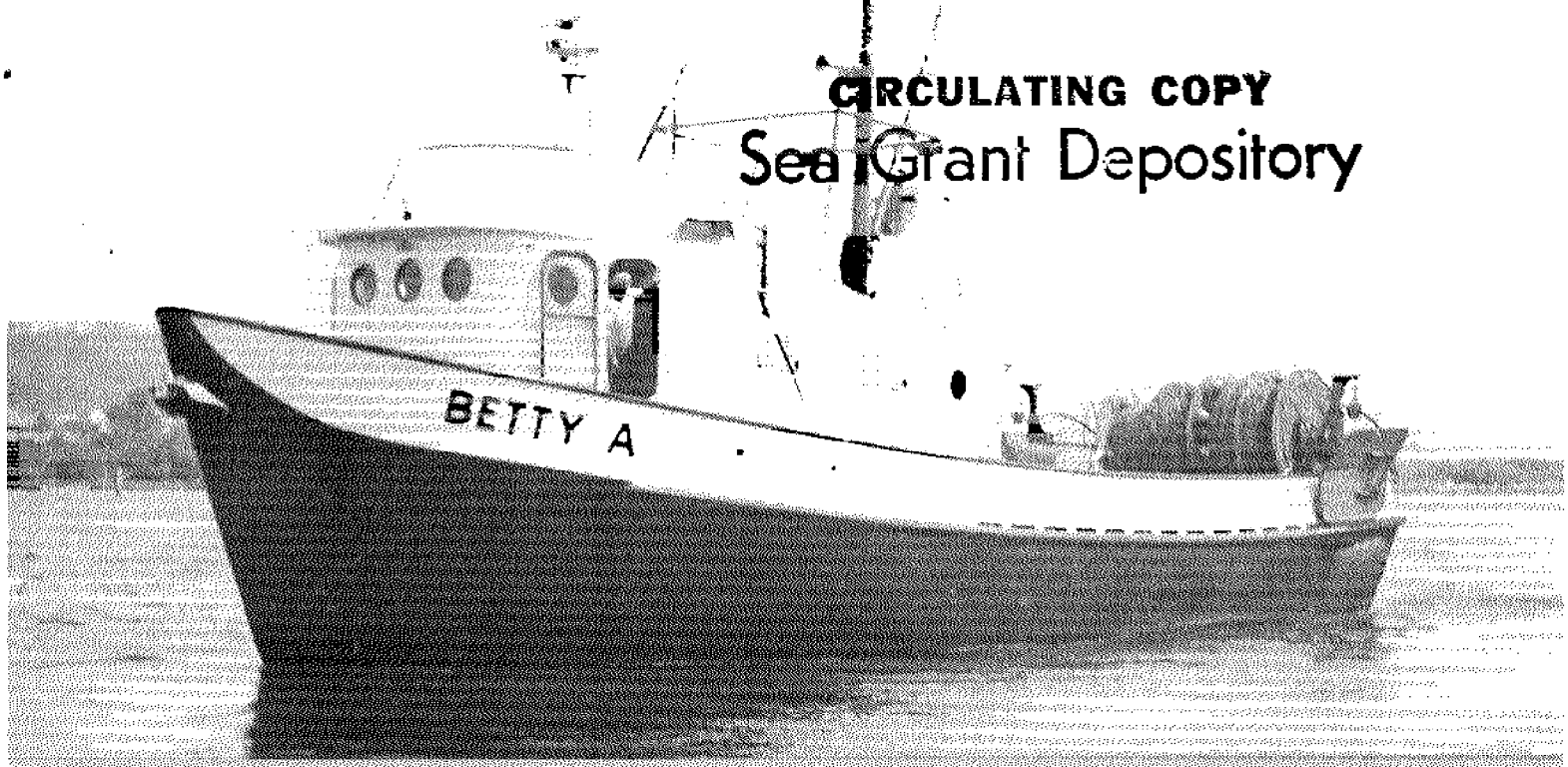

An Effective Combination Trawl for West Coast Draggers: Atlantic-Western Trawls

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Dedication

This publication is dedicated to two outstanding fishermen:

Captain Wes Johnson
Chief, Fishing Gear Operations
Industrial Development Service
Department of Forestry and Fisheries
Ottawa, Ontario, Canada

and

Captain Fred Anderson
Fishing vessel *Betty A*
Charleston, Oregon

The generosity and genius of the designer, Captain Johnson, and the patience, energy, and fishing skill of Captain Anderson brought this project to the point where it counts: "more fish over the dock."

ACKNOWLEDGEMENTS: Several individuals contributed to the successful fishing trials of this project. Without their contributions, project and publication success would not have been ensured.

Joe Forbes and the "gear men" of Gourock-Bridport-Gundry, Halifax, Nova Scotia, Canada

Captain Fred Anderson and crew of the fishing vessel *Betty A*, Charleston, Oregon

Captain Joe Easely and crew of the fishing vessel *Dare II*, Coos Bay, Oregon

Captain Maynard Desrudes and crew of the fishing vessel *Rascal*, Coos Bay, Oregon

Captain Art Anderson, owner of the fishing vessel *Margaret A*, and Instructor of Fisheries, Clatsop Community College, Astoria, Oregon

Captain Mike Rock, owner of the fishing vessel *Rainbow*, Newport, Oregon

Net Plans and Graphic Sketches: Joanne Hay

Summary

This publication describes the modification, rigging, and fishing of an effective combination otter trawl on the coast of Oregon by several Oregon otter trawlers.

The trawls were designed by Captain Wes Johnson and were modified slightly and rigged by Captain Fred Anderson and the author over a fifteen-month period.

The trawls, the Atlantic-Western Model IV-A and Model II-A, are four seam box trawls with considerable overhang, or apron. They are constructed of polythene webbing, and experience has demonstrated that they are superior trawls to those traditional trawls currently employed by Oregon draggers.

Fish landing figures from the Oregon trawlers *Betty A*, *Dare II*, *Rascal*, and *Margaret A* attest to this conclusion.

NOTE: Mention of a trademark name or a firm does not constitute endorsement. The company and trademark name mentioned in this publication supplied products actually employed in the project fishing demonstrations and trials. No criticism is implied of firms not mentioned.

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An Effective Combination Trawl for West Coast Draggers: Atlantic-Western Trawls

R. Barry Fisher

I. Introduction

A combination trawl that adequately harvests both sole and various roundfish species is a desirable net for otter trawlers in the Pacific Northwest. Pacific Northwest fishermen can proudly claim several innovations that have made their otter trawling gear more productive.

Among these are the use of hydraulically powered net reels to speed the hauling and shooting of the gear; the adoption of Chinese-V steel doors which allow easier operation of the trawl boards from stern-style trawlers; and the intensive use of rope-wrapped lower bridles and long hose or rope-wrapped tow lines (ground cables), which help to herd flatfish into the path of the otter trawl.

There has been little improvement, however, in the basic design of the trawls themselves. Large combination trawls have been designed, but, unfortunately, the overwhelming majority of West Coast draggers do not have sufficient power to successfully fish these trawls.

A good combination otter trawl for the Pacific Northwest Fisheries should offer several characteristics so that the typical Northwest dragger can use the same net to effectively capture sole species, which swim very close to the bottom and/or are buried in the bottom itself, and the various species of roundfish, which swim freely from the bottom on up to 3 or 4 or more fathoms off the bottom. Of most importance, a good combination trawl is one that can be fished effectively not only by the large Seattle draggers of high horsepower, but also by lower-powered, smaller draggers of the coastal dragger fleet. In short, an effective combination trawl should be able to serve vessels of from 90-hp to 500-hp, in relatively few sizes of nets.

II. Description of the Initial Atlantic-Western Model IV-A

The OSU program secured from Captain Johnson some rough net plans for a smaller version of the Atlantic-Western trawl used by eastern Canadian draggers. The plans were modified to suit West Coast vessels, and a trawl—designated as the Atlantic-Western Model IV-A—was ordered from Gourock-Bridport-Gundry, of Halifax, Nova Scotia, Canada.

This trawl was constructed of braided polyethelene webbing, which is slick, bouyant, does not absorb slime and mud, and withstands abrasion very well. The trawl had a headrope length of 54 feet 3 inches, and a footrope length of 78 feet 1 inch.

The wings, buntwings, wedges, and topsquare, or apron, of the trawl were constructed of 2.5 millimeter, 5-inch stretch mesh. The four bellies of equal size are constructed of 2.5 millimeter, 4½-inch stretch mesh web. The lengthening piece is of 3.0 millimeter double twine, 4½-inch stretch mesh, and the cod end is of 4.5 millimeter double twine, 4½-inch stretch mesh.

The box design of the trawl is achieved by having the wings serve as straight, vertical panels which run all the way from the breastline, or wing ends, on back into vertical bellies, and these, in turn, are carried all the way back in to the cod end. The panels are quite broad and high and this feature, coupled with a relatively long overhang of 14½ feet, gives this trawl good vertical headrope height. Added headrope height is achieved by two triangular wedges of web running from the end of the top wing onto the topsquare, or overhang. These wedges provide extra slack web and allow the headrope to "crown" and also relieve stress on the top quarter junction of wing and top-square.

The towing strains on the trawl pass directly from the bridle ends down along the headrope and footrope to the net quarters and continue in almost a

straight line down the four panel riblines to the lengthening piece and cod end. The vertical opening is thus hydrodynamically maintained and this frame of riblines provides the trawl with great structural strength. (See Net Plan I, the Atlantic-Western Model IV-A trawl, for details—page 16.)

A trawl must effectively capture both flatfish and roundfish and should be able to do it in all fishable bottom configurations. For example, on smooth bottom, the trawl should have good digging characteristics, or close contact of footrope and bottom hanging lines with the bottom to capture flatfish. It also should have simultaneous maximum headrope height, or vertical opening, to capture high-swimming roundfish. On "hard," rocky bottom, the otter trawl should work well with strings of rollers or bobbins and preserve the same high vertical headrope height and, when used with the rollers, be rigged in such a manner that the majority of the trawl web will be clear of the bottom to minimize tear-ups.

Secondary characteristics important to an effective combination trawl:

1. Simplicity in design, so that the net can be readily made and easily repaired at sea.
2. The trawl should have a good structural design which will allow the frame of the net, composed of headrope, footrope, and riblines, to bear the main brunt of the stresses and strains rather than to pass most of these strains onto the web as the gear is fished through the water.
3. This same basic structure must also take up most of the in-line strains encountered when the net is pulled onto the hydraulic net reels, which are standard equipment aboard Pacific Northwest trawlers.
4. The trawls should be so designed that it can be rigged rapidly and rerigged at sea to convert from sole to roundfish fisheries.

With these desired characteristics in mind, the Oregon State University Commercial Fishing Gear Program began, in October of 1970, to conduct trials with a type of trawl designed and developed by Captain Wes Johnson of the Industrial Development Service, Department of Forestry and Fisheries of the Canadian government, Ottawa, Ontario. Captain Johnson had developed a four-seam box trawl with considerable overhang, or apron, and flying wings which was being used successfully by large Canadian otter trawlers in the maritime provinces of Canada. The trawls were known as the Atlantic-Western trawls.

III. Initial Fishing Trials on the Oregon Coast—December 1970-August 1971

Fishing operations commenced aboard the otter trawler *Betty A*, owned by Captain Fred Anderson, of Charleston, Oregon. The *Betty A* is a 76-foot steel dragger, powered by a 340 continuous horsepower engine. The original trawl was modified to fit West Coast conditions. The flying wings were filled in by adding triangular panels of webbing to present a straight, vertical breastline wing-end of 10 feet 6 inches in height, connecting the headrope and the footrope. The wedge of webbing was 30 meshes across the head of the wing. Straight points, or siders, ran down along the bottom hanging line from the breastline. The third angle of the wedge was a straight bar cut from the top of the breastline down to the bottom panel. (See Net Plan I, Atlantic-Western Model IV-A—page 16.)

Bottom belly riblines, to further strengthen the belly, were sewn into the bottom belly. A length of ¾-inch-diameter polydacron line was lashed to the bottom hanging line, at both the quarters, where the last round mesh on each side joins the wing. These riblines were laced down into and across the belly, straight along the bar, running in from the quarter down the bar until the ribline disappeared into the opposite belly selvedge, where approximately 3 feet was laced into the opposite bottom panel selvedge line. "Permatex" nylon hanging twine was used to prevent the web from slipping along the belly riblines.

A second set of riblines was laced down the middle of the belly. Lengths of ¾-inch-diameter polydacron were lashed to the hanging line, directly on top of the middle mesh in the bottom belly. These riblines were also laced, running down the bar and into the belly until these riblines also terminated in the selvedge, where they were stopped and lashed. The result is a series of seven ribline-protected pockets of belly web. (See Net Plan I, Atlantic-Western Model IV-A—page 16.)

We had anticipated that these cross-bellied riblines would be effective in preventing excessive tearing of bellies when logs or large rocks were picked up. The effectiveness of these riblines was later proven in several instances when large chunks of coral, rock, or logs were picked up in the bottom belly. As anticipated, these heavy obstacles had a tendency to lodge

in the belly mouth and tear the webbing down, but only until they encountered a belly ribline and either dropped through and out of the net, or remained wedged in the belly and spared the trawl belly further damage.

The trawl headrope was initially rigged with 38 floats of standard 8-inch-diameter aluminum and plastic. Two-thirds of these floats were placed on the bosom and wedge headrope sections, and the remaining one-third of the floats were split equally on the two wing headrope sections. The original footrope consisted of 4-inch-diameter by 8-inch-diameter rubber spacers, hung on 9/16-inch-diameter cable in the wings, and six ¾-inch-diameter by 7-inch-long rubber spacers, hung on ¾-inch cable in the buntwings and throats.

The *Betty A* used a top bridle of 15 fathoms 8 inches, and a hose-covered bottom bridle of 15 fathoms. Hose-covered tow lines, or ground cables, of 30 fathoms were used with the vessel's standard 5½-foot by 8-foot Chinese-V-style doors.

The *Betty A* had almost immediate success with the trawl when fishing for snappers, and other roundfish in the winter of 1970-71. Her catches of snappers were consistently from two to four times more than those of trawlers fishing with 300 Easterns, 340 Easterns, the Norwegian trawl, the modified Norwegian trawl, the 400 Easterns, and the "let-out" 400 Eastern trawls. These catches were consistent throughout the entire winter rock cod fishery of 1970-71. During this period six more floats were added to the headrope to gain maximum headrope height.

When the vessel rigged over to enter the Dover sole fishery, initial fishing difficulties were encountered with the trawl. The floatation of the trawl had been cut from 44 floats to 32 to 28 floats. The polyethelene twine is buoyant and the added buoyancy and the 12-inch-long dropper chains, connecting the bottom hanging line to the footrope, allowed flatfish to escape through openings, or pockets. The openings were closed by removing the dropper chain, and the bottom hanging line was seized closely to the footropes by running a 5/16 shackle and a 2-inch-diameter ring between the bottom hanging line and the footrope cable.

The flatfish catches of the *Betty A* improved. Comparative trials against other draggers, using the trawls described previously, demonstrated that the trawl was now catching equivalent amounts of flatfish, while still maintaining three to four times the catch of roundfish over the other trawls. This proved to be a distinct market advantage for the vessel. Not only were her catches greater, but the market in Oregon encourages mixed fares.

However, it was felt that the trawl was digging too much, as the wing quarter and the belly meshes were mudded for as much as 20 to 30 meshes back from the hanging line. The wing meshes were also mudding up—in some instances 8 to 10 meshes up into the wing webbing. It should be mentioned, however, that the trawl was pulling no harder than was required to pull a 300 Eastern aboard the *Betty A*. The footrope was lightened slightly by replacing all six of the ¾-inch-diameter by 7-inch-long rubber spacers in the bunt wings with the smaller 4-inch-diameter by 8-inch-long rubber spacers. The mudding problem diminished. The catch rates also improved to a point where the *Betty A* was catching roughly 10 to 15 percent more flatfish than the other vessels and still taking three to four times as many rockfish as her competitors. We had ample opportunity to observe the difference in catching rates between the Atlantic-Western Model IV-A and a standard 300 Eastern. The *Betty A* has a split net reel, which allowed us to set and fish the two trawls with identical bridles, tow lines, and doors on a set per set basis, on the same grounds, tow after tow.

At this point, appreciation should be expressed for Captain Anderson's patience and consuming desire to continually refine and perfect the trawl. There were many instances when, because of the superior catches of the Atlantic-Western trawl, Captain Anderson would have preferred to have simply fished the Atlantic-Western. Instead, he chose to continue the controlled trials, so that we could all learn as much as possible and further improve the trawl's performance.

We realized that the average trawler on the Oregon fleet did not possess enough power to pull the heavy footrope being fished on the *Betty A*. In the early fall of 1971, we constructed footropes patterned on the styles used successfully by the New Bedford, Massachusetts, draggers. These footropes consist of round rubber discs, cut from the treads of truck tires, which are strung on chain. This chain footrope is fastened to the bottom hanging line with a shackle, connecting the chain link and a ring for lashing to the footrope at regular intervals. The discs were 4 inches in outer diameter, with a 1½-inch inner diameter hole cut in the center.

The footrope sections were made up as follows: the wing pieces were 33 feet long and were made of ⅝-inch-diameter chain. The discs were arranged on the chain so that there were 12 solid inches of discs piled together on each 15-inch length of chain links. At each 15-inch interval, a 5/16-inch shackle, carrying a 2½-inch-diameter by ⅜-inch-thick ring, was shackled into the chain. The rings are stopped, or seized, onto the bottom hanging line of the trawl. This allows the discs to roll easily on the chain when the footrope is dragged along the bottom and the trawl web is in close contact with the footrope to prevent any escape of fish.

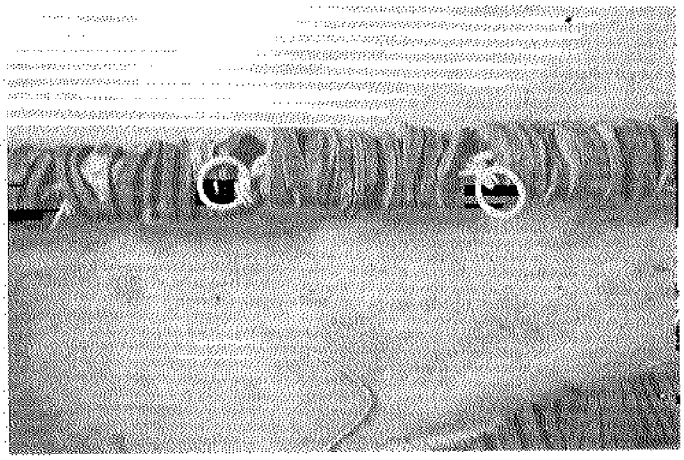


Figure 1
Completed footrope section discs, chains, and rings.

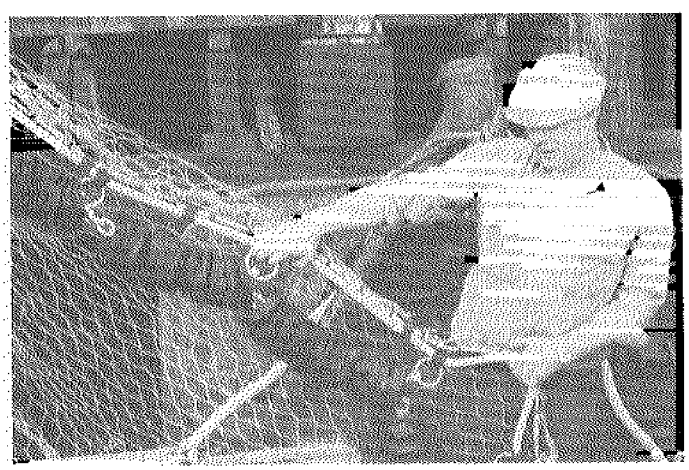


Figure 2
Disc and chain footrope aboard the F/V *Rainbow*, Newport, Oregon.

The belly section was constructed by using a ½-inch-diameter piece of chain, 11 feet 7 inches long, and the discs were proportioned on the belly section with 10 inches of discs, piled into 12 inches of chain. Again, 5/16 shackles, with the same rings, were linked into the chain every 12 inches. The rings were lashed onto the belly hanging line at 12-inch intervals. (See Headrope and Footrope Details, Model IV-A—page 18.)

This proved to be a very effective footrope. It is believed that such a footrope has distinct advantages over the rope-wrapped footropes that are commonly used in the Pacific Northwest. The footrope apparently digs as well, if not better, than the wrapped footropes. The discs cut through the mud and, while digging just as deep, do not plough up mud or tend to stick in the bottom. There is less strain on the gear. The revolutions required to move the net the same amount of distance in a tow were 75 to 100 revolutions less per minute than with the rubber spacer footrope initially used.

The flexibility of the chain permits the footrope to follow irregular contours in the bottom, and such a footrope has a very long life. Footropes of this type customarily last for as long as two and three years on the East Coast, where most of the fishing is done on hard, sandy bottom, which would destroy rope-wrapped footropes rapidly.

Another distinct advantage of such a footrope is that there have been several occasions when other Oregon draggers, equipped with rope-wrapped footropes, have had to leave the grounds because of excessive catches of starfish and pincushions. These creatures have been almost totally absent aboard the *Betty A*.

It should be pointed out that the Atlantic-Western Model IV-A is a much bigger trawl than the 300 Eastern, yet the trawl tows easier. There is sufficient weight on the footrope so that enough floats can be put on the trawl to get the full effective vertical headrope height. When sole fishing, 17 to 21 floats provided more than adequate catches of roundfish.

It was relatively easy to re-rig the Model IV-A, equipped with this footrope, for snapper fishing. Drop chains of 8 inches in length were fastened to a ring on the bottom hanging line and the chain was then shackled to the footrope wing. The floats were again increased to 38 to 42 floats, and the same superior catches of rockfish resulted.

The combination of buoyant twine, a superior footrope, good vertical headrope height, and buoyancy has proved to be a definite asset when fishing for snappers, because much of the fishing was conducted on grounds which, historically, had been thought risky or marginal by draggermen from Coos Bay, Oregon. The *Betty A* was consistently able to fish harder ground, with fewer tear-ups, than did the trawlers with conventional gear.

One final difficulty with the trawl was overcome with a minor modification. Earlier experience with the trawl showed that it had a slight tendency to have continual tears along the quarter junction of the belly and the bunt wings. The original riblines, leading from the footrope straight back in the selvedge, had the web laced tightly to them all the way to the hanging line. The webbing in the bottom belly of the trawl is hung in such a fashion so that the extra slack, between the hangings, was distributed toward the quarters. This slack was mistakenly seized to the ribline and was distributed all the way down the belly ribline. We cut the lacing of the ribline loose, from the bottom belly web, approximately 4 feet back into the belly, picked up approximately two meshes of slack in a slight pocket, and then laced the remainder of the belly evenly onto the ribline. This left a slight

pocket of slack web and effectively stopped these minor tears of the quarters.

A few more slight modifications were made to the original trawl. Riblines of ¾-inch polydacron were sewn from the breastline at a point 6 inches below the headrope, down along the laceage, which marks the junction of the dummy wing and the flying wing, to provide extra strength in the wing ends. This ribline was added so that if tears developed in the leading edge of thne forward wings, they would come to the ribline, run down the ribline, and end at the junction of the ribline and the footrope without causing further damage down into the wings.

Efforts were made to minimize contact between the webbing and the bottom at any point in back of the footrope. It had been noticed that the lower wing webbing, near the breastline, sometimes had a tendency to droop into the bottom and pick up trash. A standard 8-inch trawl float was laced into each wing, approximately 8 feet back from the breastline and 15 to 17 meshes up into the wings from the bottom hanging line. This has served to keep any slack webbing off of the bottom, while still permitting good bottom holding qualities of the footrope.

Two additional floats were laced into the side panels, approximately 5 to 8 meshes up from the bottom belly selvedge on each side, at a distance of approximately 8 feet in back of the bottom belly quarters, to keep slack web off the bottom in the beginning of the belly. Two more floats were placed on each side, at the junction of the side panels and the top bellies, approximately 1 fathom back from the joining of the lengthening piece and the bellies. This has helped to prevent undue abrasion on the bottom belly in hard bottom.

The final float configurations arrived at with this trawl aboard the *Betty A* were 24 to 28 floats for sole fishing and 38 to 42 floats for snapper fishing. In both instances, standard 8-inch trawl floats were used. The doors employed with this trawl were standard Chinese-V steel doors, measuring 5½ feet high by 8 feet 4 inches long. The bridles used were 15-fathom, rope-wrapped bottom bridles, with a diameter of approximately 4 inches. The top bridle was 15 fathoms 8 inches long.

It is strongly recommended that the bridle length be followed exactly. This is critical. The set-back of the top bridle allows the headrope to come up to its maximum vertical height and, in fact, such longer top bridles are standard on all Canadian East Coast trawlers. The tow lines, or ground cables, employed were 30 fathoms long for snapper fishing, and were either 4-inch-diameter tow ropes, sufficiently laden with chain to insure good bottom contact, or rubber hose covered cable. The tow lines, or ground cables, used for sole fishing were 60 to 70 fathoms long and were cable covered with rubber hose, running all the way to the doors.

After the modifications were completed, Captain Anderson fished the trawl for approximately six months and has since ordered two larger Atlantic-Western trawls, the Model II-A. (See page 21, Net Plan II, for description.)

Captain Anderson's testimony, and his log books and landings, established that for the six-month period the Model IV-A had caught approximately 10 to 20 percent more sole than his 300 Eastern and the gear employed by other boats in the area. In addition, his catch of rockfish and other roundfish was about three to four times that of the other vessels.

The original Model IV-A was given to the fishing vessel *Dare II*, Captain Joe Easely, of Coos Bay, Oregon. The *Dare II* is a 64-foot-long wooden dragger, powered by a 240 horsepower engine.

Captain Easely's experience with the Model IV-A aboard the *Dare II* has been equivalent to that of Captain Anderson. The trawl has consistently caught three to four times the rockfish, and is catching equivalent amounts and up to 15 percent more Dover sole and flatfish than the traditional otter trawls in the Coos Bay fleet. The trawl has managed to do this in spite of the fact that it was very badly rimracked, and the whole lower section, consisting of lengthening piece, part of the belly, and cod end, were lost when the boat's mast and boom carried away. The loss of the mast and boom resulted in the trawl being towed several miles into its home port with a full bag of fish, and the lower section of the net carried away as it was crossing the bar. A new lengthening piece and cod end were fitted and the trawl was checked for uneven strains and stretches. After these repairs were completed, the *Dare II* continued to fish effectively.

Captain Maynard Desrudes, of the fishing vessel *Rascal*, of Coos Bay, also has fished a Model IV-A Atlantic-Western, rigged with a chain and disc footrope, and has had equivalent experience. In the winter of 1971-72, the catch rates of the trawl have, at times, even exceeded the three or four to one margin over the conventional gear. There are six Atlantic-Western Model IV-A trawls fishing on the Oregon Coast, and the experience is consistent in all vessels—a three or four to one margin in rockfish catches, and a 10 to 15 percent higher production of flatfish. They have continued to duplicate the test result while fishing against all trawls commonly employed on the West Coast: 300, 340, and 400 Easterns; the let-out 400 Eastern; the Norwegian trawl and the modified Norwegian trawl.

IV. Observations on Door Spread and Headrope Height

We have had no opportunity to accurately measure horizontal or vertical spread on the trawls. The spread between the doors seems to demonstrate that there is slightly better horizontal spread when angles are measured along known distances from the towing blocks to the stern. This is a common measurement index on all Oregon trawlers. Combined measurements seem to indicate, roughly, 8 to 13 percent more spread between the doors on several boats. It is difficult, if not impossible, to translate this into claims for better spreading ability, since these are rough indicators and do not measure accurately and definitely. In several instances, we have had other draggers attempt to pick up the headrope floats on their depth-recorders to give some indication of the headrope height of the trawl. These readings are, at best, very inaccurate, and have been taken in shallow water, usually in depths of from 15 to 35 fathoms. There are, however, consistent, depth-recorder readings of from 12 to 16 feet vertical headrope height. The Oregon State Commercial Fisheries Program does not have the equipment to perform accurate measurements. Captains Anderson, Desrudes, and Easely have, however, maintained the only kind of measurements that this program feels are valid. They have consistently caught more fish.

Finally, one other experiment deserves mention: Captain Art Anderson of the fishing vessel *Margaret A*, of Astoria, Oregon, and Professor of Fisheries at Clatsop Community College, obtained the plans for the Atlantic-Western Model IV-A trawl from the author in the fall of 1970. Captain Anderson decided, with our concurrence, to test the trawl's effectiveness using the standard 42-thread nylon webbing used on the West Coast. He did not have any 5-inch stretch mesh webbing on hand, so constructed the entire trawl of 4½-inch stretch mesh nylon.

The reader will note that the Atlantic-Western Model IV-A plans call for 5-inch stretch mesh webbing in the buntwings, wings, wedges, and topsquare. The bellies, lengthening pieces, and cod ends are of 4½-inch stretch mesh. Captain Anderson's trawl was built without adding extra meshes in the wings, buntwings, topsquare, and wedges to compensate for the smaller mesh.

Captain Anderson's trawl was put aboard the *Margaret A* in the winter of 1971. The *Margaret A* is a 60-foot wooden dragger, powered with a D-13,000 series Caterpillar of 130 horsepower. It immediately began to outfish other trawls in the Astoria fleet on roundfish, and obtained equivalent catches of flatfish. It should be noted that the *Margaret A* is somewhat limited in power, and the footrope employed on this trawl is a standard rope-wrapped footrope, favored by most Oregon draggers. The production of the Coos Bay draggers convinced Captain Anderson that his trawl should be re-built with the polyethelene web and, in the fall of 1971, the nylon webbing was replaced with polypropelene web and a 5-inch stretch mesh was used in accord with the plans. It is his feeling that this modification has improved the trawl's catching abilities, and the vessel's landings bear this out.

The Atlantic-Western Model IV-A trawl can be fished with a chain and disc footrope (as described) by any coastal trawler capable of towing a 300 Eastern with a 4-inch-diameter rope-wrapped footrope and standard Chinese V-style doors of 6 feet by 4 feet. More power is needed to tow the roller, or bobbin, footrope (described on page 18—Headrope and Footrope Details, Model IV-A.) Vessels with less than 190 horsepower, continuous, should not contemplate towing this footrope.

Belly sections of rollers and wing sections of rubber discs are widely used on the Atlantic Coast and this combination should prove valuable in bottom too hard for discs alone. This footrope can be towed by any vessel capable of towing a 300 Eastern, with a belly section of rollers.

V. The Atlantic-Western Model II-A: An Evaluation

Captain Fred Anderson, of the *Betty A*, has a large and powerful dragger for the Oregon Coast. The boat is 76 feet long and has a 345 horsepower continuous Caterpillar engine. Early in the trials of the Model IV-A, we were tempted to purchase and test the Atlantic-Western Model II-A trawl, which has become a standard trawl in the eastern Canadian fleet. In the fall of 1971, such a trawl was procured from Gourock-Bridport-Gundry, of Halifax, Nova Scotia, Canada. This trawl was cut on almost identical patterns with the smaller, modified Model IV-A, but has a footrope of 107 feet 4 inches and a headrope of 74 feet 6 inches. The wing panels are broader, all sections of the trawl are larger, and the trawl has an overhang of approximately 19 feet.

The Canadian Ministry of Fisheries has testified that this trawl can gain from 18- to 20-foot headrope height. The trawl also has a longer tapered lengthening piece, unlike the straight, taperless lengthening piece of the Model IV-A trawl. (See Net Plan II, Atlantic-Western Trawl, Model II-A—page 21.)

This trawl is recommended by the Canadian officials for any vessel having 325 to 350 horsepower. The mesh size in the trawl is similar to that in the Model IV-A in that the wing, buntwing, topsquare, and wedge meshes are 5-inch stretch mesh, and the remainder of the trawl is 4½-inch stretch mesh. This trawl also uses 2.5-millimeter web for the bellies, wings, square, wedges, and buntwings. The lengthening pieces, again, are of 3.0-millimeter double twine 4½-inch stretch mesh, and the cod ends are of 4.0-millimeter double twine 4½-inch stretch mesh web.

The Model II-A has an added ribline, which runs along the bottom of the trawl, from the flying wing ribline down the body of the trawl to the lower part of the bottom belly selvedge. This ribline of 1-inch-diameter polypropelene is a "shock-absorber" and helps prevent excessive tear-ups if the wings hang up. (See Net Plan II, Atlantic-Western Trawl, Model II-A, page 21.)

This trawl has been rigged with a footrope similar to those described with the Model IV-A, with the exception that 6-inch-diameter rubber discs have been used in the throat section of the belly, and 4½-inch-diameter rubber discs have been used on the wing footropes. During the 1971-72 snapper fishery, a section of belly rollers was made up consisting of 14-inch round rubber bobbins, mounted on steel cable of ¾-inch-diameter, with two 4-inch-diameter by 8-inch-long rubber roller spacers placed between the larger rollers for snapper fishing in hard bottom.

The trawl was rigged with 53 floats for snapper fishing and the bridles were 15 fathom 1 foot top bridle, and 15 fathom, rope-wrapped 4-inch-diameter bottom bridle.

It is still too early to make strong or assertive claims to the added effectiveness of this trawl over the Atlantic-Western Model IV-A. The trawl fishes evenly on rockfish with the Model IV-A trawls on the first set in the morning for snappers. Moreover, the trawl has consistently caught more snappers on the second set of the day, as the fish have been leaving the bottom and coming up in the water column. A few soundings have been taken of the trawl's headrope and these seem to average 18 to 20 feet.

The trawl has since been re-rigged to go Dover sole fishing and has proven to be highly satisfactory. There have not been many opportunities to compare the trawl with trawlers using conventional gear, but early evidence seems to indicate that even greater amounts of rockfish are being taken, as incidental catch with the flatfish, even against the Atlantic-Western Model IV-A vessels. The flatfish catches have been excellent, on a par with, or slightly better than the Model IV-A trawls. In the few opportunities presented, the larger trawl has beaten the smaller Atlantic-Western Model IV-A.

It should be stressed that poor weather conditions and little fishing time in the winter of 1971-72 have not given us ample evidence to evaluate this trawl.

Fragmentary evidence does demonstrate, however, that the added size of the trawl has more than justified the purchase. Captain Anderson has just purchased a second Atlantic-Western Model II-A, which will be rigged with rollers and bobbins to fish in harder bottom for snappers, and the first Model II-A aboard the vessel will be rigged with a sole footrope of chain and discs. The *Betty A* will then have the option of fishing either for snappers in hard bottom or sole, from her split net reel.

Larger draggers on the West Coast should consider this trawl carefully for fishing in rocky bottom for perch and rockfish. The minimum power required to fish this trawl, with roller or bobbin footropes, is 350 horsepower. Vessels with slightly less power could fish the trawl with rubber disc footropes, as described. Large trawlers in the maritime provinces of Canada have had great success with this trawl in hard bottom. Captain Johnson can describe his successful experience, since he designed and developed these trawls for rigorous fishing for roundfish on hard bottom. (The Net Plans, Cutting Plans, and Headrope and Footrope Details for the Atlantic-Western Model II-A Trawl are illustrated on pages 21, 22, 23, and 24.)

VI. Cutting Patterns and Assembly Procedures: Atlantic-Western Model IV-A

The cutting patterns for the Atlantic-Western Model IV-A and the Atlantic-Western Model II-A trawls are shown on pages 17 and 22. Because the trawls use two different sizes of stretch mesh, it is impossible to cut the trawls out of a single sheet of webbing. The cutting panels are self-explanatory and the tapers have been drawn in, for clarity and accuracy, so that fishermen building their own trawls will have little difficulty in cutting their sections. *It must be noted that one mesh should be allowed for every taper cutting in the trawl sections.* The mesh counts that are given are for full-size sections, and one mesh should be added to these mesh counts when cutting. When ordering webbing for this net, extra sheets of webbing should be ordered for patching material. Mending twine should also be ordered, as the use of nylon is not recommended (polythene twine is also less expensive).

Assembly Instructions for the Atlantic-Western Trawl Model IV-A

The bellies of the trawl should be assembled first. All four bellies should be laced together by gathering three or four knots from each panel and lacing the bellies together with double twine needles of 3.0-millimeter twine. The lacing should consist of two or three half-hitches and/or a Miller's hitch, followed by a round turn on the next row of meshes and, then, a repeat of half-hitches and/or Miller's hitch, and a round turn, etc.

To prevent confusion, one panel should be marked as the bottom belly and another panel marked as the top belly. The next step is to sew the topsquare onto the top belly. All sections of the net that are sewn together should be sewn together with either a double mesh needle and/or a different colored twine, such as #42 thread nylon twine, to make sure, when the net is assembled, that the sections are being laced together and joined at the correct points. Also, the use of double needle and/or different colored twine will facilitate repairs when the net is torn while fishing.

The next step is to assemble the wing sections by sewing the buntwing to the side panel bellies. The wing is joined to the buntwing and the flying wing to the wing. Again, distinctive seaming twine should be used.

The side panel bellies with assembled wings should now be laced to the top belly and square. It is important to temporarily tack, or tie, the assembled sections together at the proper junction points to insure that the selvedges are laced evenly. Three or four knots on each side of the panels should be laced together, as a tack at the top end of the bellies and junction of the topsquare and buntwing, where there is a 62-mesh count on the top belly and 62 meshes at the termination of the wings. A second tack should be made at the junction of the buntwing to the forward edge of the topsquare. The mesh counts here are 92 at the topsquare and 75 at the top of the buntwing.

A check should be made to make sure that the top parts of the wings are being sewn to the top belly. This is easily done because the top edge of the wing panels and the edge of the top belly and square both have a one-bar, one-mesh taper, as distinguished from the bottom panels of the wings, which have a straight line of points, or siders, with no taper.

The panels should be laced together in the manner described above, with a double needle of 3.0-millimeter polyethelene twine, with three half-hitches, or a Miller's hitch, followed by a round turn through the next mesh, and, then, a repetition of the half-hitches, or Miller's hitch, etc.

All of the wing edges, top and bottom, and the edge of the wedge, which are to be fastened to the headrope and the bottom hanging line, have a selvedge. This is formed by gathering four knots and making fly-meshes, as is shown in the sketch on page 20. A double needle of twine should be used. Gather four knots together, go down two bars, making a loop, or dog-ear, and hitch onto another gathered four knots, gathered into a selvedge. When the trawl is hung on the headrope and the bottom hanging line, these fly-meshes, or loops, are used for the hangings.

The body of the trawl is now completed. The next step is to assemble and lace in the wedges. These wedges are important, as they give the headrope a "crowning" effect and allow it to rise in an even curve to its maximum height. The bar cut section of the wedge will be hung onto the headrope. (The assembly details are shown in the sketch on page 20.) The taper of the top wing is two bars and one mesh. The taper on the inside edge of the wedge is one bar, one mesh. The tapers do change at this point, and the four knots selvedge is gathered from the wing and four knots from the wedge in the laceage, which is done as described previously. Continue to lace with four knots gathered from the wedge and wing, evenly, mesh for mesh, until the buntwing and topsquare is reached.

The change in the taper, from wing to wedge, permits, when the trawl is completed, a straight in-line pull from the wing-end of the headrope all the way down through the riblines and the panels of the net. Follow the plan and tie the five end meshes of the wedge to a single point, then join them all to the first mesh of the wing. The bottom section of the wedge is sewn evenly with a double needle, mesh for mesh, onto the topsquare until all 18 meshes have been sewn in. The last bar of the seam should be tied off on a topsquare mesh.

The trawl is now ready for hanging. The Net Plan gives the appropriate hangings and great care should be taken to space the hangings in accord with the instructions given in the Net Plans. The hangings on the bosom of the Atlantic-Western Model IV-A are 2¾ inches apart on both the topsquare bosom, or throat, and the bottom belly bosom, or throat. The wing hangings on the headrope are 4½ inches per fly-mesh, and the hangings on the bottom hanging lines are 4½ inches per fly-mesh. Attention should be paid to make sure that the hangings are spread evenly. The hangings of the loops, or fly-meshes, of the wedges are hung in 3 inches per fly-mesh, on the headline.

A non-slip double needle hanging twine, such as Perma-Grip in ±42 thread, makes a superior hanging line, as this twine does not slip readily on synthetic fibres.

The headrope on the Atlantic-Western trawl is 54 feet 3 inches long, made up in three pieces of ¾-inch-diameter combination wire rope. The spliced lengths are 12 feet 5 inches for the wing, plus 29 feet 5 inches for the wedges and bosom, or throat, and 12 feet 5 inches for the other wing. When these three pieces are connected, with 2-inch shackles, a total headrope height of 54 feet 3 inches will result.

The bottom hanging line is made of 1-inch-diameter polydacron line, and the hangings are hung in, as given previously, 4½ inches per fly mesh, or loop, and 2¾ inches for each round mesh on the bottom belly. It is recommended that the bottom hanging line be slightly longer than the finished footrope configuration of 78 feet 1 inch, so that there is approximately 18 inches to 2 feet of slack of hanging line on each wing, and approximately 1 foot of slack on the bottom belly hanging line, when measured against the footrope. This slack allows the bottom hanging line to be stopped evenly onto the footrope and makes sure that there is adequate slack, so that the footrope, and not the bottom hanging line, will bear the strain of towing.

The next step in the assembly of the trawl is to rig the riblines, which will run from the quarters, on both the headrope and the footrope, down along the four selvedge seams in the body of the box trawl. (The sketches on page 19 show how these riblines are rigged.) They may be joined with either steel rings and roller chains, as is shown in the sketches, or the ends may be simply eye-spliced and seized into the quarter junctions.

Again, attention should be paid to the method of joining the web to the bottom riblines on each quarter. Earlier in this publication, we discussed the modification of leaving the first three or four feet of the web along the ribline, back from the bottom hanging line, free of lacing to prevent tears. The first laceages should be strong and secure, so that the selvedges will not slip on the riblines. The first laceages should be made by half-hitching and stopping, with a non-slip synthetic fibre, with a double needle of twine, and, at least eight or nine half-hitches should be taken. This seizing should then be cross-hitched to prevent slipping. The four belly panel selvedges should be laced and seized evenly to the top and bottom riblines.

The cutting plans for the cod end and lengthening pieces of the Atlantic-Western Model IV-A trawl are shown on page 17. These should be made up by gathering three knots from each panel edge to make four laceages. The laceages are made with double needle twine of three half-hitches to a mesh around through the next mesh, and half-hitches and round mesh hitch, etc., throughout the length. It is recommended that the cod end laceages be hitched at each mesh, rather than allowing a round turn through the mesh on every other mesh. When the lengthening piece and the cod end are completed, they should be sewn onto the bellies, and the four riblines should be continued on down the lengthening piece and the cod end, to the very end of the cod end. The riblines are eye-spliced at the end to serve as emergency lifting straps.

The cod end and splitting strap details should be left to the individual fisherman's preferences. The trawls used in this project had 8 splitting strap rings sewn onto the cod end, 21 meshes up from the bottom (½-inch-diameter by 3-inch-diameter rings were used for the splitting strap rings). Four of them were attached, one to each panel selvedge, and one in the middle of each panel with ½-inch-diameter polydacron "spider" ropes providing riblines to support the webbing and the rings in the middle of the panels. This proved to be very satisfactory and strong. The "spider" riblines also prevented the cod and web from distending, or stretching, disproportionately. Once the web was stretched, this allowed splits of approximately 3,500 to 4,000 pounds of flatfish and approximately 3,000 pounds of snappers per split.

VII. Rigging of the Atlantic-Western Model IV-A

The recommended footrope for the Model IV-A is a chain and rubber disc configuration (shown on page 18 under Headrope and Footrope Details, Model IV-A). Attention is also drawn to Figures 1 and 2, page 8, which show the completed chain and disc footrope assembly and the footrope hung onto the bottom hanging line of an Atlantic-Western Model IV-A trawl, on the fishing vessel *Rainbow*, of Newport, Oregon. The wing sections are made of ⅝-inch chain, 33 feet 3 inches long, and the center section is made of half-inch chain, 11 feet 7 inches in length.

The rubber discs can be obtained from Gourock-Bridport-Gundry, Ltd., P.O. Box 5005, Armdale, Halifax, Nova Scotia, Canada. We are currently making inquiries from an American supplier, Noratlantic Diesel Company, of Front Street, in Fairhaven, Massachusetts.

Because this footrope has proven to be so efficient, the Oregon State University Commercial Fishing Gear Program is attempting to have dies made, so that these rubber discs can be manufactured here on the West Coast for easier procurement.

It should be pointed out that these footropes are quite expensive. A full rootrope for the Model IV-A Atlantic-Western trawl costs approximately $270-$280, but it must be remembered that the trawls fish very effectively over somewhat harder bottom than is possible with the conventional gear. It is reasonable to expect two to three years of full-time fishing with such a footrope, with only minor adjustments. From time to time, the footrope should be measured to make sure that the chains have not stretched excessively. If stretching does occur, links should be removed from the stretched footrope sections until the original configuration of 78 feet 1 inch is reached, in correct lengths fo each section.

The trawl can be fished with rollers or bobbins and 12- or 14-inch-diameter solid rubber bobbins should be used in the footrope, bosom, or throat piece, separated by two 4- or 5-inch-diameter by 8-inch spacers and normal roller chains. The buntwing section should be made up of 12-inch or 14-inch bomb-nosed, or egg-shaped, ring rollers, separated by three or four of the 8-inch-long spacers and roller chains. The flying wing section should be made up of bomb-nosed rollers of the same diameter, with eight 8-inch spacers in between, on out to the end of the wing, where one bomb-nosed roller should be used to clear the breastline and bottomwing from hang-ups or snags. (See Headrope and Footrope Details, Model IV-A, page 18.)

If the rubber discs and chains are used for snapper fishing alone, a 6- or 8-inch dropper chain should be inserted between the footrope and the bottom hanging line to allow the trawl to obtain maximum vertical opening and to keep the web completely off the bottom.

Every vessel will find that the floatation of the trawl will vary. Good initial starting results can be obtained by using 17 to 21 floats when the trawl is rigged mainly for sole fishing, and 28 to 35 floats if the chain and rubber discs are used for snapper fishing. Naturally, the trawl can carry more floats if it is fished with bobbins, and it is recommended that approximately 40 floats be used if bobbins or rollers are employed with the trawl.

Any new trawl requires some experimentation before maximum efficiency is obtained. The following general rules are put down as guides to individual fishermen:

1. If a trawl does not make contact with the bottom, reduce the number of floats and, perhaps, add small increments of chain to the footrope.
2. If a trawl is digging too much, increase the floatation.
3. If the trawl still continues to dig too much, take up 6 inches on each side of the footrope.
4. If the trawl doesn't take bottom satisfactorily, with less than the recommended number of floats, slack the footrope back 6 inches on each side.

These changes of the headrope and footrope configurations should, in most instances, prove unnecessary. Floatation increases and decreases and or weights should balance the trawl so that it fishes effectively. One ironic point should be made: for some reason, there have been only two instances (among eight Atlantic-Western trawls on the West Coast) when the trawl has fished effectively on its first set. We cannot explain this. We can only theorize that the trawl needs one or two sets for all the meshes to pull up tight and the net to adjust itself to the various riblines.

The assembly instructions have been given for those fishermen who are interested in making their own nets. All of the trawls that we have used, with the exception of the trawl aboard the *Margaret A*, in Astoria, Oregon, have been purchased from Gourock-Bridport-Gundry, Ltd. The workmanship, quality, and price of these trawls is excellent. Captains Anderson, Desrudes, Easely, and Rock have all testified that they have never seen a better-made trawl. It is not the intention of the OSU program to endorse this

company, or any commercial concern, but our fishing experience over fifteen months on several boats with trawls manufactured by this concern, plus the captains' endorsements, lead us to recommend that fishermen consider the trawls manufactured by this company.

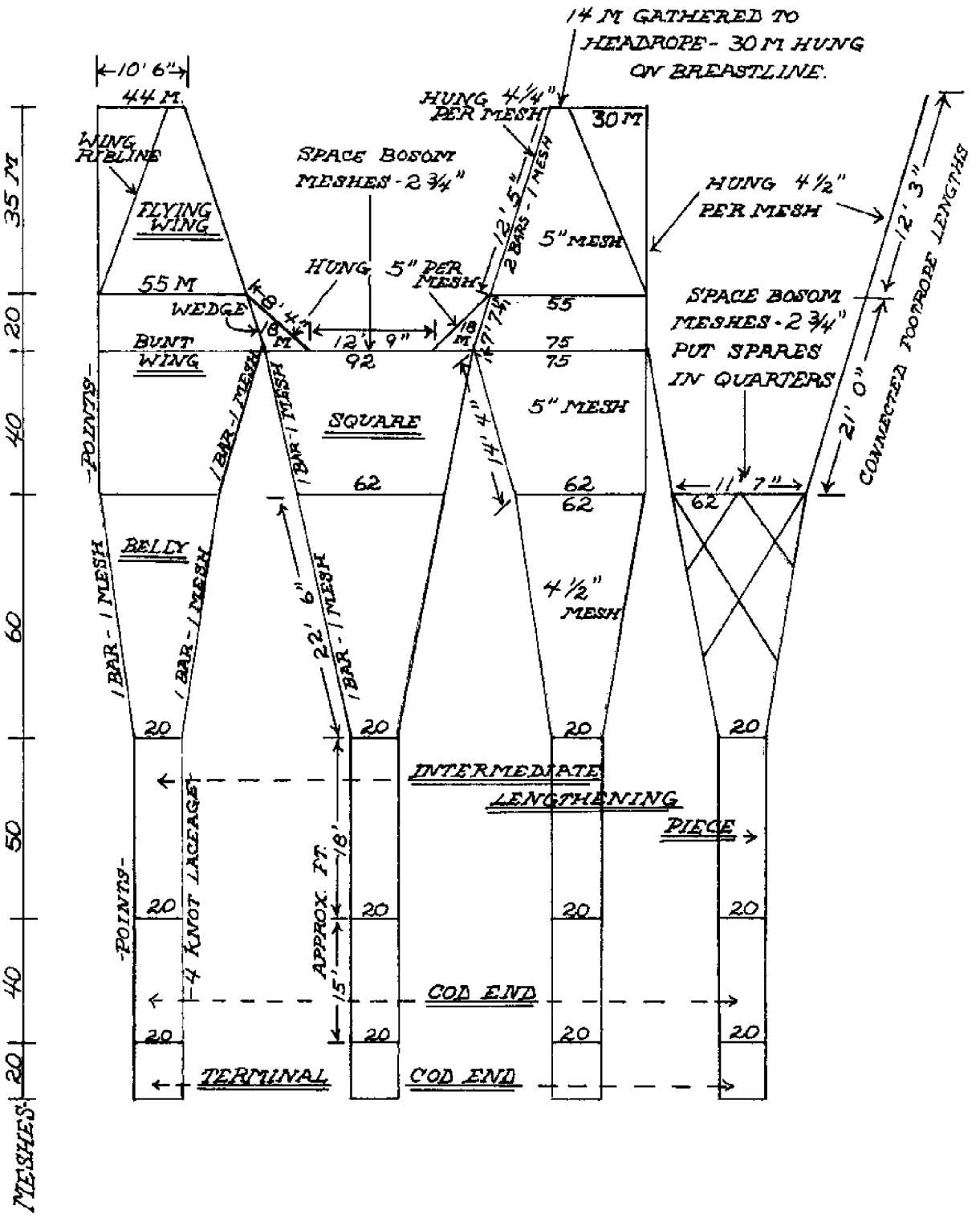
The price of a completed Atlantic-Western trawl from Gourok-Bridport-Gundry, Ltd., assembled with all riblines hung to the headrope and bottom hanging lines, breastlines, etc., is $495. Import duties must be paid on the trawl. These duties amount to approximately $230. Brokerage fees and freight rates amount to approximately $85, for a total price of $810. To this cost must be added, of course, the cost of the floats, footrope, and cod end rigging gear. The approximate total cost of putting this trawl into the water, ready to fish, with a rubber disc and chain footrope, is approximately $1,100. It normally takes the company approximately three to four weeks to manufacture the trawl and ship it to the West Coast.

VIII. Conclusion

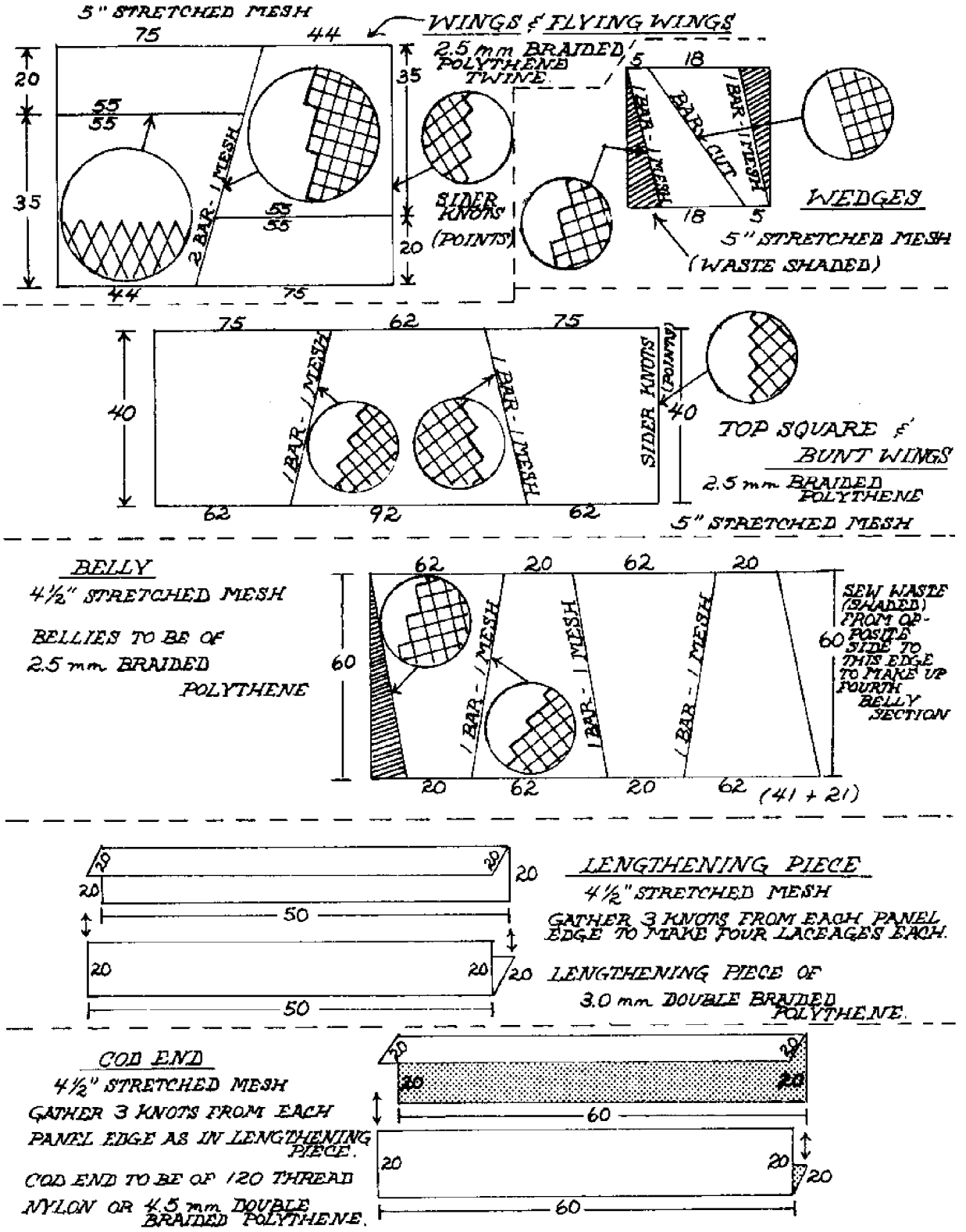
Further information about the trawls, and advice and help in rigging, may be obtained from the Commercial Fisheries Program of the Department of Fisheries & Wildlife, Oregon State University. The superior catching capability of the trawl over a considerable period of time in the commercial fisheries of Oregon has convinced me that West Coast fishermen should consider the use of these trawls.

Appendix A

ATLANTIC WESTERN TRAWL
MODEL IVA



Appendix B



— CUTTING AND TAPERS —

NOTE: 1 MESH ALLOWED FOR EVERY TAPER.

MODEL

ATLANTIC WESTERN TRAWL IV A

Appendix C

HEADROPE AND FOOTROPE DETAILS
MODEL IV A

HEADROPE: 54'-3" MADE IN 3 PIECES - 12'5" + 29'5" + 12'5" 3/4" DIAMETER COMBINATION ROPE

FOOTROPE: 78'-1"-

RUBBER DISC TYPE: WING - 33'3" - 3/8" DIAMETER CHAIN + BOSOM 11'-7" 1/2" CHAIN + WING 33'-3" 3/8" DIAMETER CHAIN

ROLLER OR BOBBIN TYPE: - 1/2" WIRE ROPE - MADE IN 5 PIECES:

12'-1" + 20'-9" + 11'-5" + 20'-9" + 12'-1" WHEN SHACKLED TO EQUAL 78'-1"

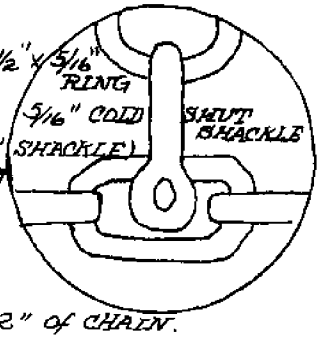
BOSOM SECTION OF BOBBINS CAN BE COMBINED WITH WING SECTIONS OF RUBBER DISCS.

NOTE: ALL FOOTROPES TO BE 78'-1"

FLOATS: STANDARD 8" DIAMETER TRAWL FLOATS.

RUBBER DISC FOOTROPE:
SOLE FISHING - 17-21 FLOATS
ROUND FISHING - 28 - 32 FLOATS

ROLLER OR BOBBIN FOOTROPE.
38 - 45 FLOATS DEPENDING ON BOTTOM

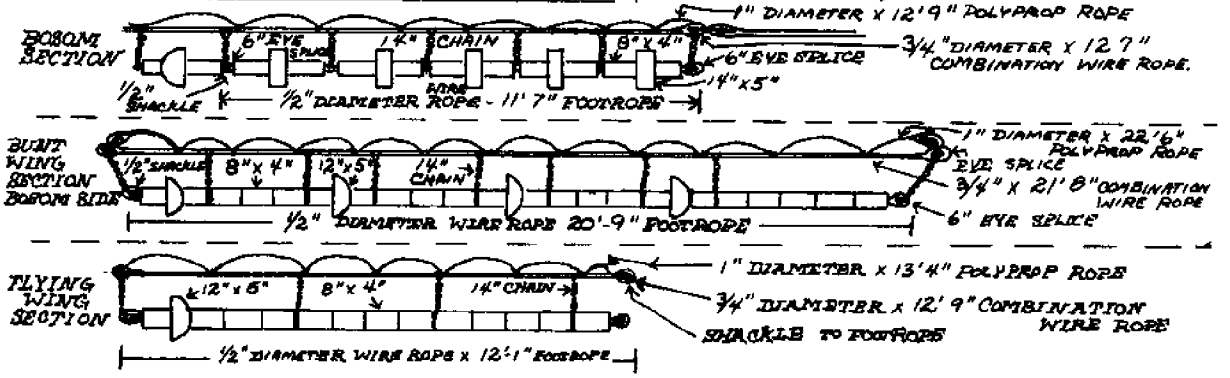


FOOTROPE CHAIN DETAILS:

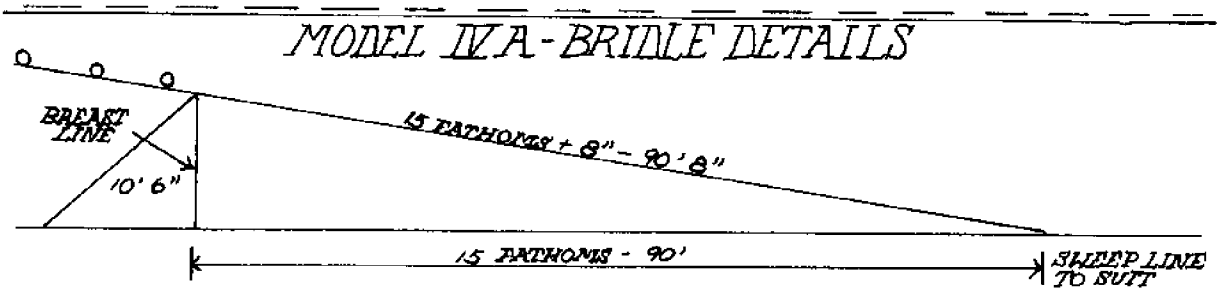
10" of 4 1/2" DIAMETER RUBBER DISCS - HUNG IN 12" of CHAIN.

15" of 4 1/2" DIAMETER RUBBER DISCS - HUNG IN 18" of CHAIN.

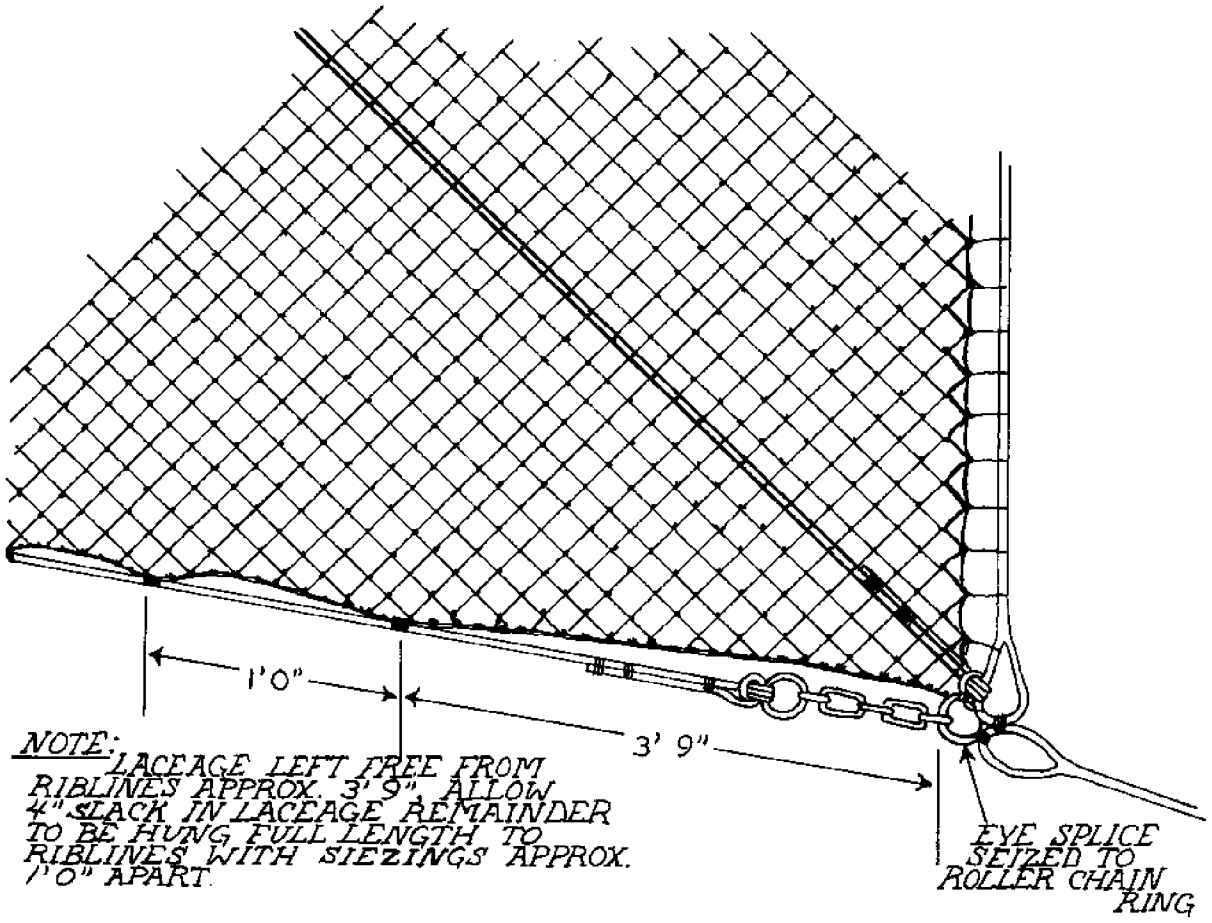
FOOTROPE ROLLER OR BOBBIN DETAILS: (NOT TO SCALE)

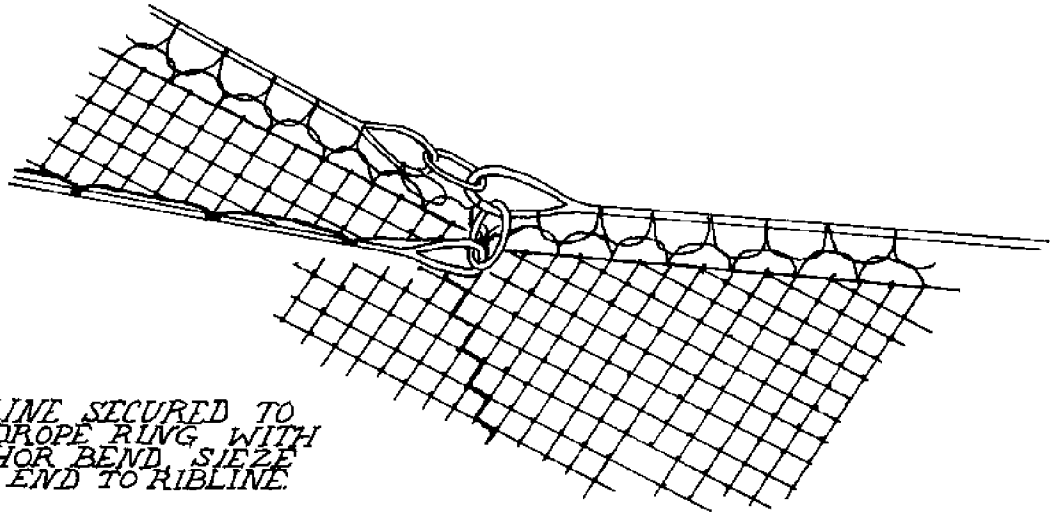


MODEL IV A - BRIDLE DETAILS

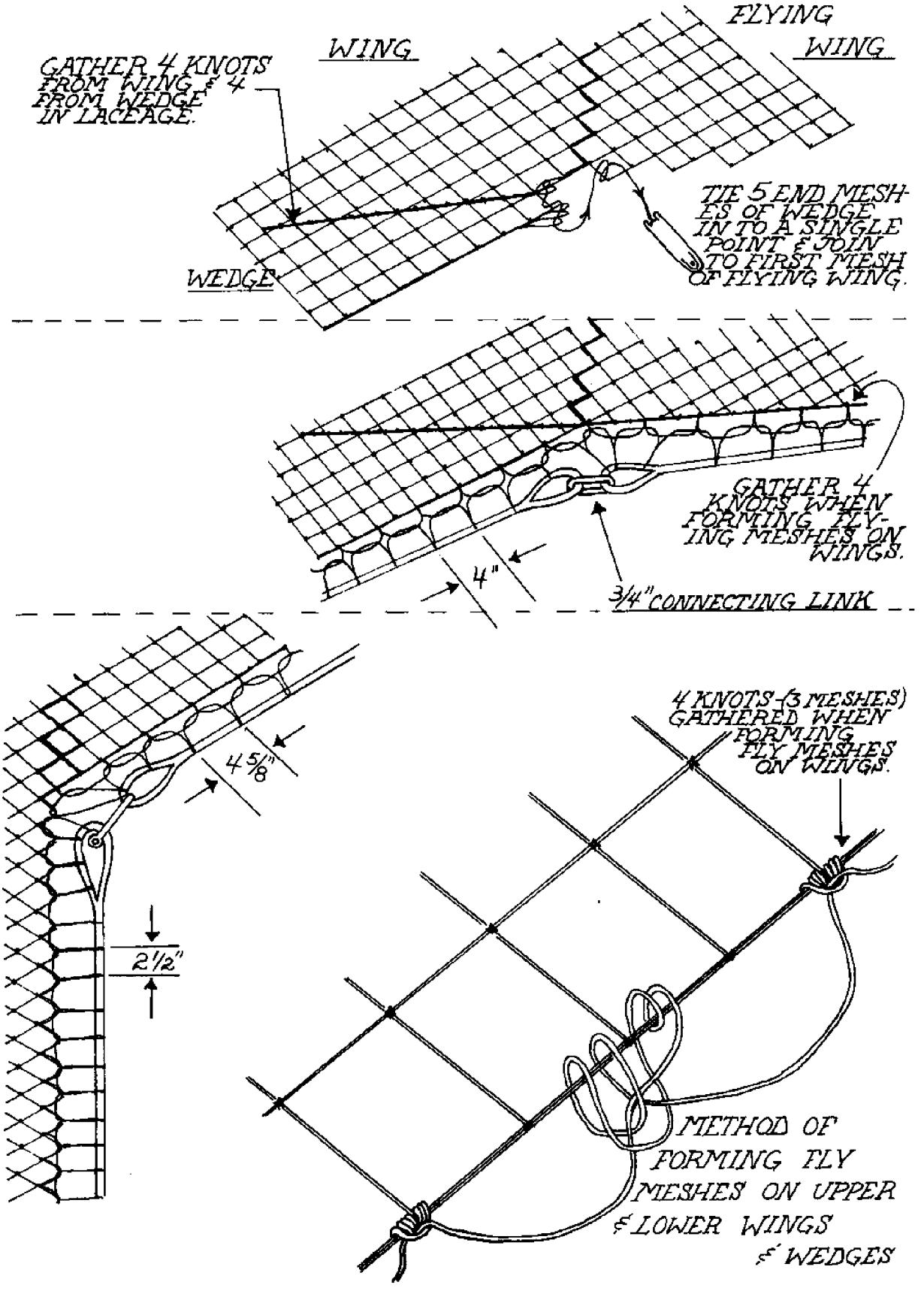


Appendix D

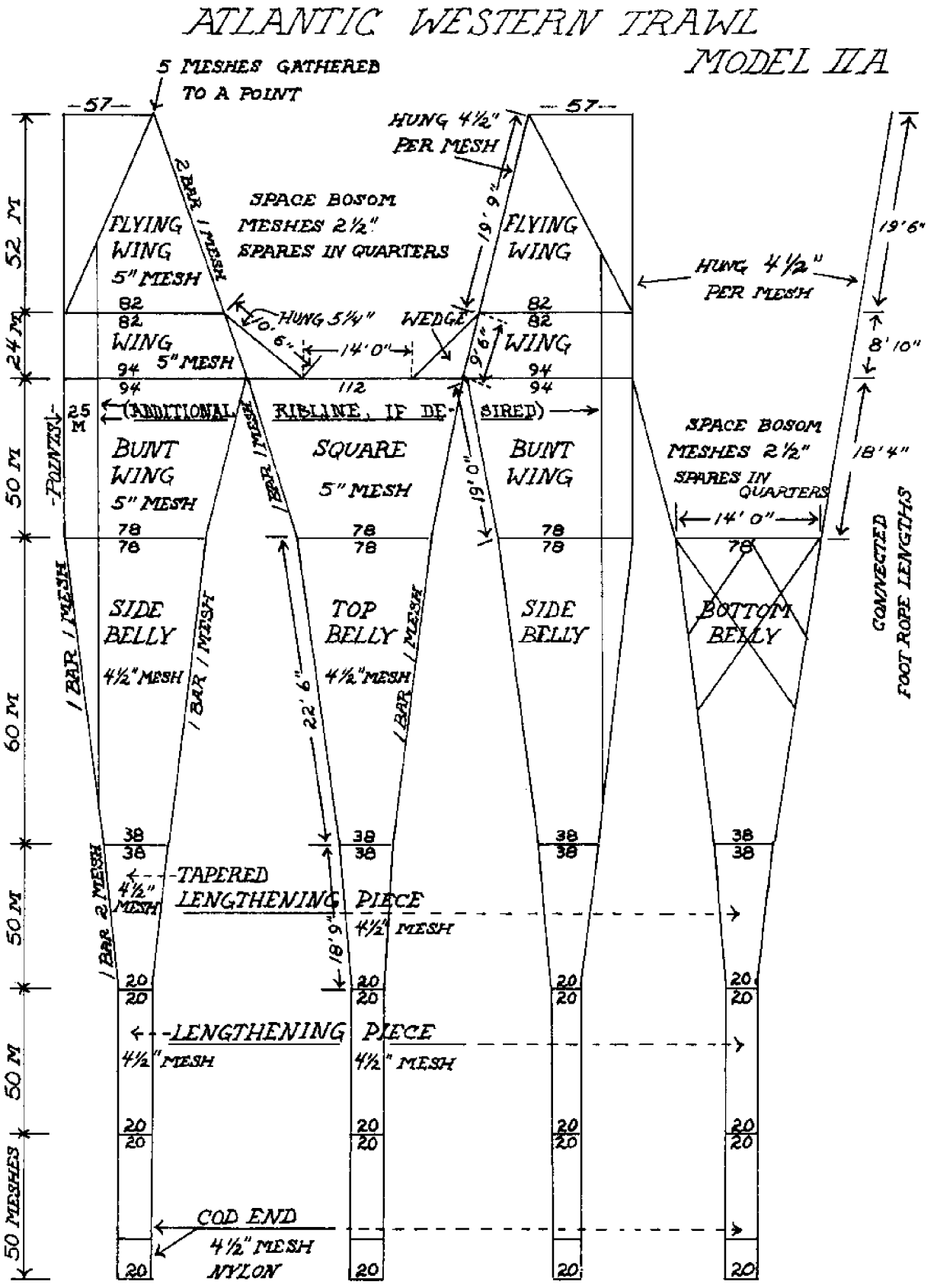

1'0"
3' 9"
NOTE: LACEAGE LEFT FREE FROM RIBLINES APPROX. 3' 9" ALLOW 4" SLACK IN LACEAGE REMAINDER TO BE HUNG FULL LENGTH TO RIBLINES WITH SIEZINGS APPROX. 1'0" APART.
EYE SPLICE SEIZED TO ROLLER CHAIN RING


RIBLINE SECURED TO HEADROPE RING WITH ANCHOR BEND, SIEZE FREE END TO RIBLINE.

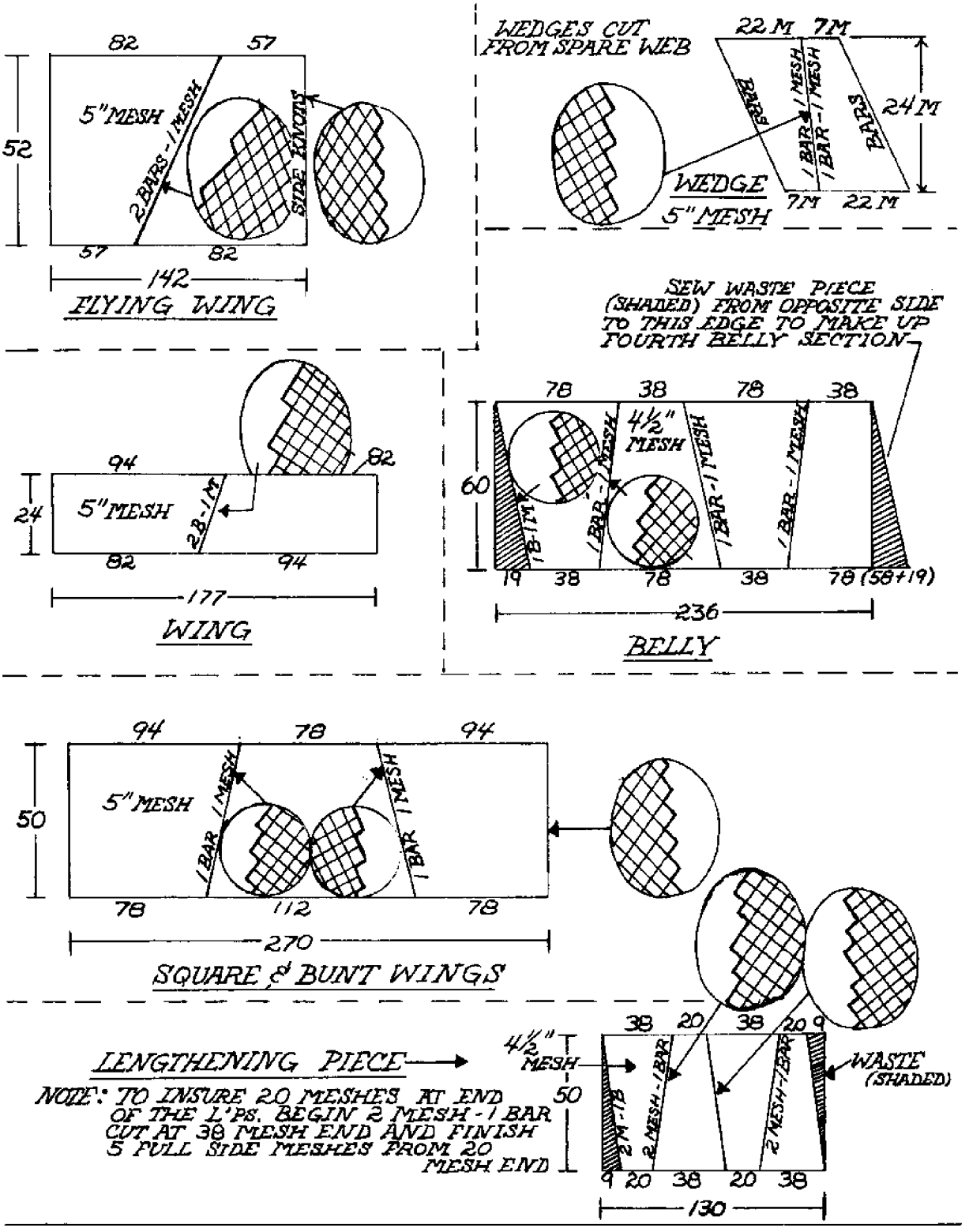
Appendix E


FLYING WING
WING
GATHER 4 KNOTS FROM WING & 4 FROM WEDGE IN LACEAGE.
TIE 5 END MESHES OF WEDGE IN TO A SINGLE POINT & JOIN TO FIRST MESH OF FLYING WING.
WEDGE
GATHER 4 KNOTS WHEN FORMING FLYING MESHES ON WINGS.
4"
3/4" CONNECTING LINK
4 5/8"
2 1/2"
4 KNOTS (3 MESHES) GATHERED WHEN FORMING FLY MESHES ON WINGS.
METHOD OF FORMING FLY MESHES ON UPPER & LOWER WINGS & WEDGES

Appendix F


ATLANTIC WESTERN TRAWL
MODEL IIA
5 MESHES GATHERED TO A POINT
57
57
HUNG 4½" PER MESH
SPACE BOSOM MESHES 2½" SPARES IN QUARTERS
FLYING WING 5" MESH
82
82
WING 5" MESH
94
94
112
HUNG 5¼"
6"
14' 0"
WEDGE
9' 6"
19' 9"
FLYING WING
82
82
WING
94
94
HUNG 4½" PER MESH
19' 6"
8' 10"
18' 4"
SPACE BOSOM MESHES 2½" SPARES IN QUARTERS
14' 0"
CONNECTED FOOT ROPE LENGTHS
52 M
24 M
50 M
60 M
50 M
50 M
50 MESHES
25 M
POINTS
(ADDITIONAL RIBLINE, IF DESIRED)
BUNT WING 5" MESH
78
78
SQUARE 5" MESH
78
78
BUNT WING
78
78
78
2 BAR / MESH
1 BAR / MESH
19' 0"
SIDE BELLY 4½" MESH
TOP BELLY 4½" MESH
SIDE BELLY
BOTTOM BELLY
22' 6"
38
38
1 BAR 2 MESH
4½" MESH
TAPERED LENGTHENING PIECE
4½" MESH
18' 9"
20
20
LENGTHENING PIECE
4½" MESH
4½" MESH
COD END
4½" MESH NYLON

Appendix G

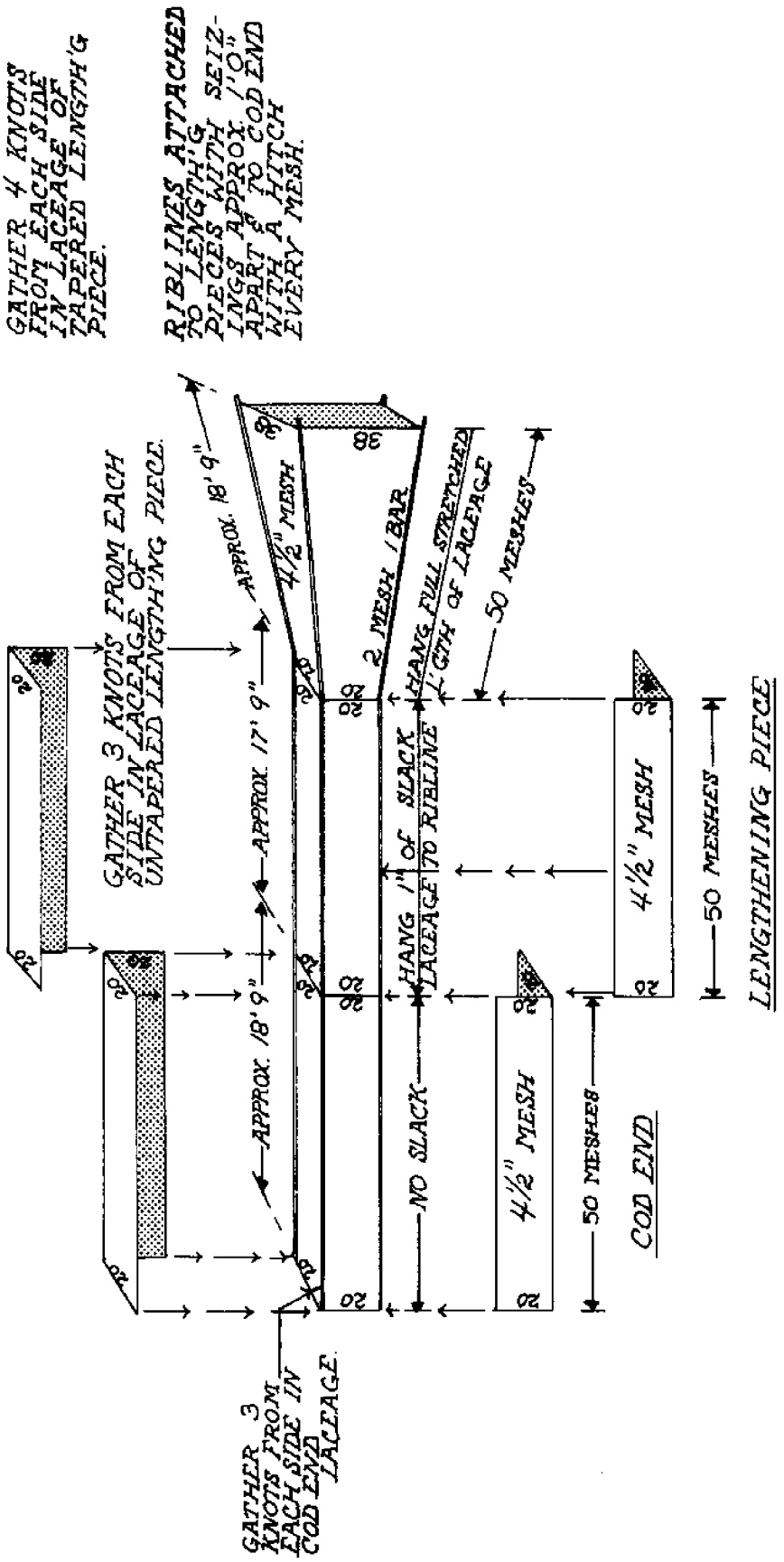


CUTTING AND TAPERS

NOTE: 1 MESH ALLOWED FOR EVERY TAPER.

ATLANTIC WESTERN TRAWL
MODEL IIA

Appendix H



COD END AND LENGTHENING PIECE DETAILS

ATLANTIC WESTERN TRAWL

MODEL IIA

Appendix I

HEADROPE AND FOOTROPE DETAILS MODEL IIA

HEADROPE - 74'-6" MADE IN 5 PIECES - 19'-9" + 10'-6" + 14'-0 + 10'-6" + 19'-9"
¾" COMBINATION ROPE.

FOOTROPE - 107'-4"
RUBBER DISC TYPE:- WING - 46'-8" ½" DIAMETER CHAIN + BOSOM 13'-6" ¾" DIAMETER CHAIN + WING 46'-8" ½" DIAMETER CHAIN.

ROLLER OR BOBBIN TYPE:- ⅝" DIAMETER WIRE ROPE - MADE IN 7 PIECES -
19'-0 + 8'-8" + 18'-2" + 13'-6" + 18'-2" + 8'-8" + 19'-0
(WHEN SHACKLED TO EQUAL 107'-4")

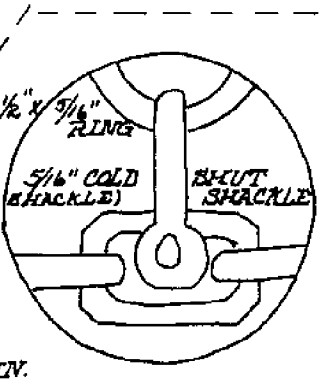
BOSOM SECTION OF BOBBINS CAN BE COMBINED WITH WING SECTIONS OF RUBBER DISCS.

NOTE: ALL FOOTROPES TO BE 107'-4"

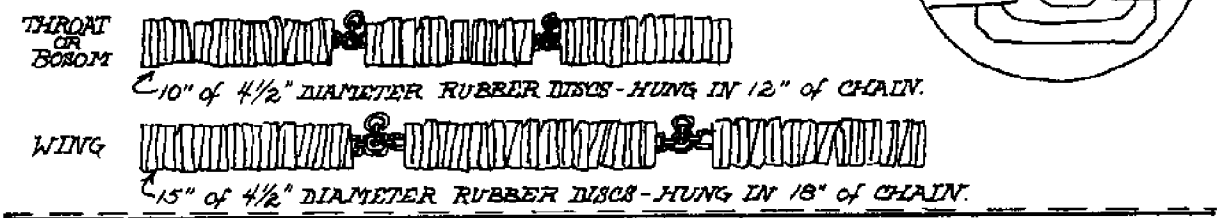
FLOATS: STANDARD - 8" DIAMETER TRAWL FLOATS

RUBBER DISC FOOTROPE:
SOLE FISHING - 32 - 38 FLOATS
ROUND FISHING - 40 - 46 FLOATS

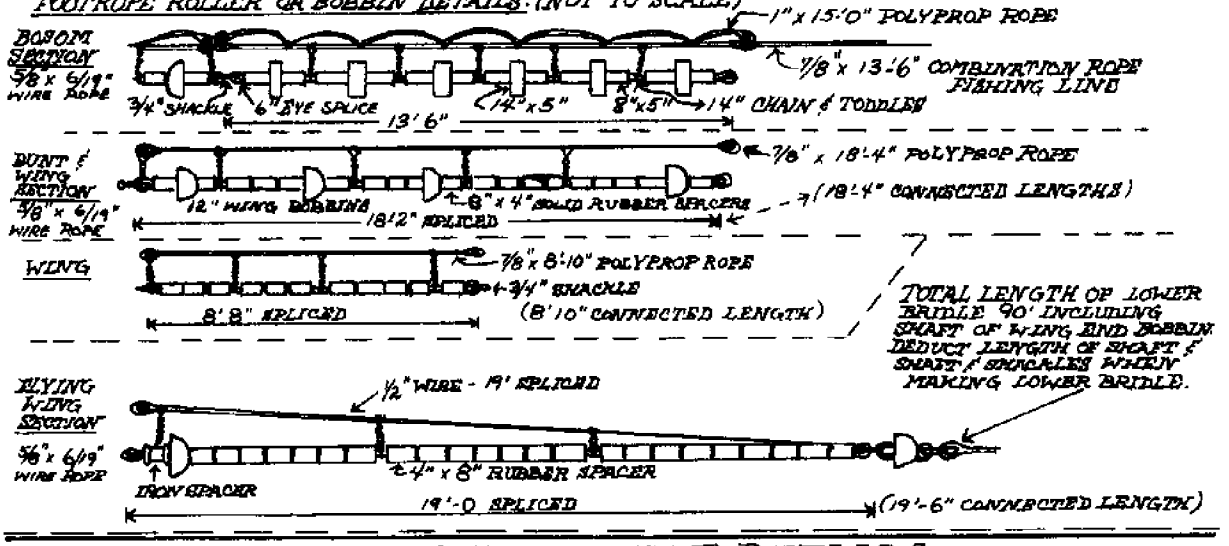
ROLLER OR BOBBIN FOOTROPE:
50 - 55 FLOATS - DEPENDING ON BOTTOM.



FOOTROPE CHAIN DETAILS:



FOOTROPE ROLLER OR BOBBIN DETAILS: (NOT TO SCALE)



MODEL IIA - BRIDLE DETAILS