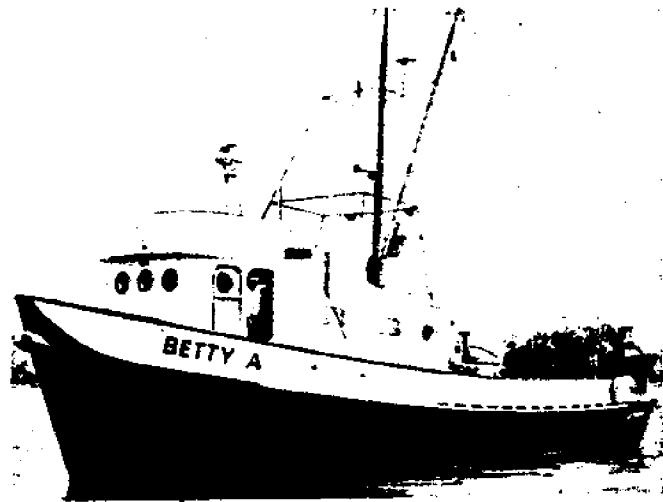


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An Effective
Combination Trawl for
West Coast Draggers:
ATLANTIC-WESTERN TRAWLS



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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

The late Captain Art Anderson, owner of the fishing vessel *Margaret A*, and Professor 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 trawls on the Pacific Northwest Coast 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 three-year period.

The trawls, the Atlantic-Western Model IV-A, IV-A- $\frac{3}{4}$, 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 West Coast draggers.

Fish landing figures from West Coast trawlers 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.

AUTHOR: R. Barry Fisher is Extension Fisheries Development Specialist and Associate Professor of Fisheries, Department of Fisheries and Wildlife, Oregon State University.

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, unfortu-

nately, 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 polyethylene 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 the 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 19.)

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 sidars, 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 19.)

Bottom belly riblines, to further strengthen the belly, were sewn into the bottom belly. A length of $\frac{3}{8}$ -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 $\frac{3}{8}$ -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 19.)

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. An 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 twari 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 3/4-inch-diameter by 7-inch-long rubber spacers, hung on 3/4-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 5 1/2-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 polyethylene 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 dropped 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 this 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 3/4-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 1 1/2-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 3/4-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 2 1/2-inch-diameter by 3/8-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.

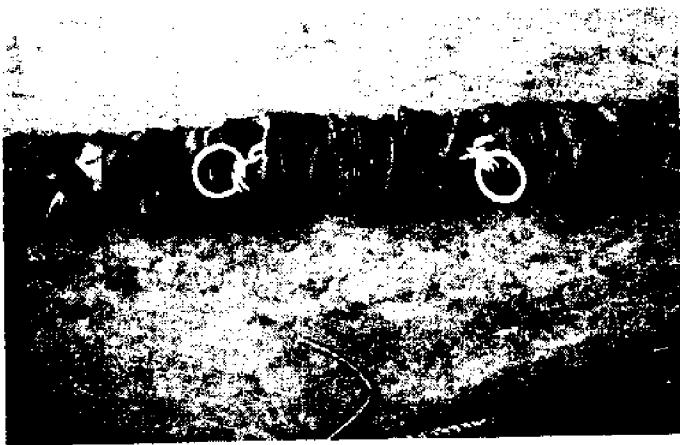


Figure 1
Completed footrope section discs, chains, and rings.

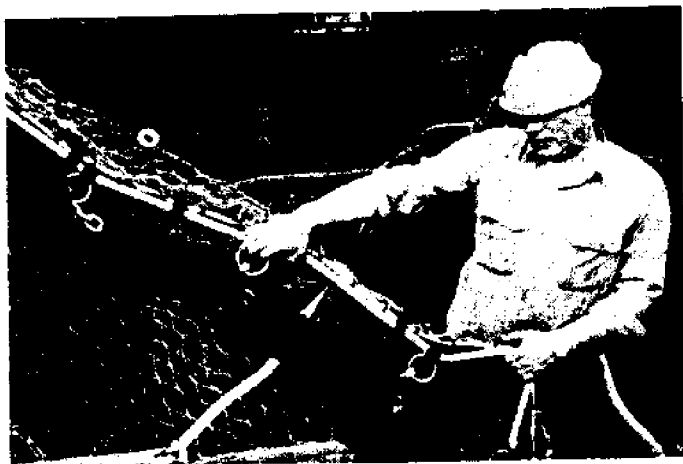


Figure 2
Disc and chain footrope aboard F/V *Rainbow*, Newport, Oregon.

The belly section was constructed by using a $\frac{1}{2}$ -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, $\frac{5}{16}$ 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 21.)

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 draggersmen 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.

On 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 $\frac{3}{8}$ -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 the 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 Easley, of Coos Bay, Oregon. The *Dare II* is a 64-foot-long wooden dragger, powered by a 240 horsepower engine.

Captain Easley'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 had 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.

Since these initial trials, 1970-72, approximately 120 trawls have been successfully fished in British Columbia, Oregon, Washington, and California.

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 Easley 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: The late 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 340 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 25.)

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 polypropylene 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 25.)

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 off 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 25 through 29.)

VI. The Atlantic-Western Model IV-A-3/4: An Evaluation

In 1972 and 1973, several small draggers on the Oregon coast and in Northern California successfully fished a smaller model Atlantic-Western trawl. The trawl is called the Atlantic-Western Model IV-A- $\frac{3}{4}$. The original trawl was designed for a 33-foot vessel, the *Sally D*, of Brookings. The *Sally D* is powered by a GMC 271 engine, which develops 46 horsepower at 1,800 revolutions per minute. The *Sally D* has a 3-1 reduction gear and swings a 30-inch by 20-pitch propeller. Captain David Olson of the *Sally D* wanted to try dragging. The commercial fishing gear program at Oregon State University worked with Captain Olson in designing and specifying dragging gear appropriate for the *Sally D*, such as winches, net reels, Chinese V doors, nets, etc. For this boat, we decided that Chinese V doors of the following dimensions were appropriate for the Model IV-A- $\frac{3}{4}$ trawl: 52 inches long, 32 inches high, constructed of 3/16 inch plate, with 2 $\frac{1}{2}$ -inch diameter shafting for the bottom shoe. The shoes extended up the leading and trailing edge of the door for 11 inches. One and one-quarter inch pipe framed the top of the door and then extended down the leading edge; the trailing edge was welded into the 2 $\frac{1}{2}$ -inch shafting. The bails were constructed of $\frac{1}{2}$ -inch thick plate with $\frac{3}{8}$ -inch rod welded around the edge of the bail. A $\frac{1}{4}$ -inch-thick by 2 $\frac{1}{2}$ -inch-wide by 52-inch-long piece of plate was used as reinforcing across the back of the door. Pad eyes for the hook lines, tail chains, etc. were constructed of $\frac{1}{2}$ inch rod. The doors weighed 175 pounds each.

The Atlantic-Western Model IV-A- $\frac{3}{4}$ trawl has a headrope of 40 feet 6 inches and a footrope of 64 feet, (see page 32 for net plan). The trawl is constructed of polyethylene twine, as are the other Atlantic-Western trawls. As the name suggests, the trawl is actually the Model IV-A with all sections being reduced 25 per cent. The original trawl had a 58-foot footrope but, during fishing trials the footrope length was increased to 64 feet and the wings were hung tight to give greater effectiveness on fishing sole species.

The flying wing, buntwing, and top square sections in this trawl were constructed of 5-inch stretch mesh polythene; the bellies, intermediate or lengthening piece, and codend were constructed of 4 $\frac{1}{2}$ -inch stretch mesh webbing. The original trawl webbing was of 15/24 twine for the wings, buntwings, squares, and bellies. The lengthening piece was of 15/32 polythene twine, and the codend was constructed of 4.5mm braided polythene twine. The headrope was made of three pieces of $\frac{3}{8}$ -inch hard-laid polypropylene rope with the wing sections made in 9 feet 4 inches each and a center section of 21 feet 10 inches, including eye splices. The splices were seized to-

gether; the flying wings were hung into the 9 foot 4 inch wing pieces; and the wedges and top square bosom meshes were hung evenly into the 21 foot 10 inch center piece (see page 30 for net plan details).

The footrope on the *Sally D* was made to the following specifications; polydacron rope of $\frac{3}{8}$ -inch diameter was made into three sections of 27 feet 8 inches for each wing and a 10-foot 8-inch section for the bottom belly bosom. These pieces were measured complete with eye splices on each end of each rope. The ropes were shackled together, and $\frac{3}{8}$ inch diameter chain was bighted and seized along the wing rope sections with 15 links of chain being hung in and seized securely to a stretched length of 12 links (see page 32 for footrope rigging details). The center section was made of $\frac{1}{2}$ -inch diameter chain, rigged in the same manner—15 links hung into the space of 12 stretched links. A heavier footrope was not used because of the limited power and comparatively small doors of the *Sally D*.

The net proved to be very successful. On "scratch fishing" the *Sally D*'s catches compared favorably with the catches of boats with three, four, and five times the vessel's horsepower on sole species, and she got more than her share of round fish, i.e. snappers, ling cod, rock fish, etc. Naturally enough, on heavy fishing, larger, more powerful draggers with much larger nets and doors did catch more fish; however, under conditions of heavy fishing, Captain Olson shortened his tows to maintain the catching efficiency of the net. It should be noted that any trawl will lose its catching efficiency when large amounts of fish are in the net, as the greatly increased weight and mass of fish have a tendency to diminish the mouth opening of the net.

The *Sally D* used 10 fathom bridles and 20 fathom tow lines or ground cables. The bottom bridle was rope wrapped to a diameter of 2 $\frac{1}{2}$ inches, and the 20 fathom tow lines or ground cables were covered with surplus hose to give a diameter of 1 $\frac{1}{2}$ inches.

It should be pointed out that the most successful sole fishermen on the West Coast employ this technique of using large diameter bottom bridles and ground cable or tow lines when sole fishing to herd the flat fish into the path of the net.

On two occasions, the author has used wrapped and covered bridles and tow line or ground cables against bare cable bridles and tow lines or ground cables with the same net. In both instances, the catch of flat fish was approximately 50-70 per cent greater when the covered or large diameter bridles and tow lines were used.

The Model IV-A-¾ trawl is believed to have a headrope height of from 8-10 feet. The trawl is rigged with from 9 to 13 plastic trawl floats of 8 inch diameter. The trawl is rigged in exactly the same fashion as the large Model IV-A with riblines of ½-inch diameter polypropelene running along the selvages of all four seams. The top seam riblines have an eye splice and are securely seized to the junction of the wing and center sections headrope eyes on each side and are laced securely to the selvages all the way down to the end of the codend. When hanging the riblines, approximately one inch of slack ribline is allowed for each 12 inches of new webbing. As the web knots take up and slack comes out of the web, this ribline slack will disappear. The two bottom seam riblines again are eye spliced and seized securely to the junction of the wing and bosom hanging lines and are laced along the bottom seam to the end of the codend in the same manner as the top seam riblines.

The bottom belly of the Model IV-A-¾ also has crossed riblines of ½-inch polyprothene rope laced in a criss-cross pattern across the bottom belly as do the Model IV-A and the Model II-A Atlantic-Western trawls (See pages 30, 31, and 32 for net plan, headrope and footrope details and cutting patterns for the Model IV-A-¾ trawl).

Since the initial success of the *Sally D*, several small West Coast draggers in Oregon and Northern California have fished the Model IV-A-¾ with various footrope configurations, which are given on page 32. This trawl will work well with any vessel having from 45-165 horsepower, with a suitable reduction (at least 3-1) and propellers suitable for dragging. These trawls are also made by Courock-Bridport-Gundry of Halifax, Nova Scotia, and the trawl has

become very popular in the small boat fleet in the Maritime Provinces of Canada.

Any fisherman desiring to fish this trawl for round fish would be well advised to follow the instructions given on page 7 of this publication (Station Bulletin 613) and rig drop chains between the bottom hanging line and the footrope. Fishermen with vessels in the higher horsepower range of the class described here, for example, 120-160 horsepower with suitable reduction gears and propellers, should consider using a footrope composed entirely of rubber discs and chain. The discs do dig well for sole species and will give long life. The intermediate horsepower range (90-120) should consider using a center section of discs and chain as described on page 32, head and footrope rigging details with chain bighted or hung on a rope footrope for the wing sections. Vessels in the low horsepower range in this class (45-90 horsepower) should consider using a straight rope and chain footrope.

It is also recommended that larger boats in this category of 40 to 55 feet should lengthen out the codend or intermediate lengthening piece to 40 mesh deep intermediate and 40 mesh deep codend. See Appendix O, V-wing cutting diagram and rigging instructions. The V-wing door end is believed to be superior to a straight vertical breast line because when the net is being towed through the water, the breast line will sag back in a V and allow slack webbing in the bottom wing to drag along the bottom. This added tension results in a downward drag on the headrope and also bothersome small tears in the bottom wings. The V-wing cut removes this slack web, and it is felt that a slightly greater headrope height can be attained.

VII. Cutting Patterns and Assembly Procedures: Atlantic-Western Trawls

The cutting patterns for the Atlantic-Western Model IV-A, Atlantic-Western II-A, and the Atlantic-Western IV-A- $\frac{3}{4}$ are shown on pages 20, 26, 27, and 31. 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 cut 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. The wing sections for the Model II-A and Model IV-A should be cut separately so these trawls have three wing sections of wing, bunt wing, and fly wing. It is recommended, however, that the flying wing and bunt wing for the Model IV-A- $\frac{3}{4}$ trawl be cut in one section as is described in the cutting plan on page 31. 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 Trawls

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 3.0mm twine. For the Model IV-A, Model II-A, and Model IV-A- $\frac{3}{4}$, double twine needles of #42 thread nylon or double 3.0mm polyethylene should be used. 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 with either a double mesh needle and/or a different colored twine, such as #42 thread nylon twine, should be checked to make sure when the net is assembled that the sections are laced and joined together 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 because the section outline can be easily seen.

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 wings should now be laced to the top square. Only the buntwing is joined to the square. The mid wing and flying wing will be hung on the headrope and footrope hanging line. It is important to temporarily tack or tie the assembled sections together at the proper junction points to insure that the selvages 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 top square and buntwing.

The panels should be laced together in the manner described above, with a double needle of 3.0mm polyethylene twine for the Models II-A and IV-A being used. For the Model IV-A- $\frac{3}{4}$, the lacing, again, is of #42 thread nylon or single 3.0mm twine.

All of the wing edges, top and bottom, which are to be fastened to the headrope and the bottom hanging line, have a selvedge. This is formed by gathering four knots and lacing the bunched meshes into a selvedge, as is shown in the sketch on page 23. A double needle of twine should be used. After the selvedge is completed, fly meshes or dog ears are made. A double needle is used (Appendix E, page 23). The needle is fastened to the selvedge and then go down two bars, making a loop, or dog ear, and hitch onto the 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 23.) 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. A four-knot selvedge is gathered from the wing, and four knots from the wedge and/or laceage is made, 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 top squares seam are reached.

The change in the taper, from wing to wedge, permits, when the trawl is completed, a straight inline 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 end meshes of the wedge to a single point (as shown in Appendix E page 23.) 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 the round meshes have been sewn in. The last year of the seam should be tied off on a top square mesh to make a three legger.

The trawl is now ready for hanging. The net plans give the appropriate hanging directions and great care should be taken to space the hanging in accord to the instructions. For example, the hangings on the bosom on the Atlantic-Western IV-A are $2\frac{3}{4}$ inches apart on both the top square, or throat, and the bottom belly bosom, or throat. The wing hangings on the headrope are $4\frac{1}{4}$ inches per fly mesh, and the hangings on the bottom hanging lines are $4\frac{1}{2}$ 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 5 inches per fly mesh, on the headline. Study the hanging instructions carefully for each trawl.

A non-slip double needle hanging twine, such as Perman-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 Model IV-A trawl is 54 feet 3 inches long, made up in three pieces of $\frac{3}{4}$ 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 one-inch diameter polydacron line, and the hangings are hung in, as given previously, $4\frac{1}{4}$ inches per fly mesh, or loop, and $2\frac{3}{4}$ 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 there is approximately 18 inches to 2 feet of slack of hanging line on each wing, and approximately one 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.

Hanging directions for the Atlantic-Western Model II-A are similar to the directions for the Model IV-A with the hangings given in inches per mesh for both the headrope and the footrope. It should be noted on all the Atlantic-Western trawls that the headrope and footrope hang line sections are made

up in pieces. This is purposely done to make repairs easy. If a headrope or footrope is parted on a hangup, the parted section can be cut out and a new one joined in so that the entire headrope or footrope hanging line does not have to be rehung or replaced. Also, the riblines can be attached easily and securely to the appropriate points on the headrope and on the footrope hanging lines.

The net plans also show the lengths into which each section of net is hung in feet and inches for all of the trawls.

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 bos trawl. (The sketches on page 22 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.

Three-quarter inch hard laid polypropelene rope should be used for riblines for the Model II-A trawl. Five-eighths inch hard laid polypropelene should be used for the riblines for the Model IV-A. One-half inch diameter hard laid polypropelene should be used for the Model IV-A- $\frac{3}{4}$ riblines.

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 laced selvedges will not slip on the riblines. The first laceages should be made by half-hitching and stopping with a double needle of non-slip 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, and for each selvedge all the way to the end of the cod end.

The cutting plans for the cod end and lengthening pieces of the Atlantic Western trawls are shown in the Appendices. The cod ends should be made up by gathering four knots from each panel edge to make a laceage of six meshes for each selvedge. 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 Model II-A and IV-A trawls used in this project had 8 splitting strap rings onto the cod end, 21 meshes up from the bottom. (One-half-inch by three-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.

The splitting straps on the Atlantic-Western IV-A-¾ were rigged by counting up 10 meshes from the bottom of the cod end and a splitting strap ring was seized securely to each selvedge on the cod end. The splitting strap was roved through them and, once the web was stretched, this allowed splits of approximately 1,000 pounds of flatfish and 800 to 900 pounds of roundfish.

VIII. Bridle Rigging on the Atlantic-Western Trawls

Experience has demonstrated that the bridles should be rigged to match different depths when fishing Atlantic-Western trawls.

The trawls were originally designed to be fished with longer top bridles. Careful examination of the footrope and headrope rigging plan details of each trawl will show this longer top bridle. The Model IV-A Atlantic-Western is rigged with 15 fathom bridles, but the top bridle has an extra 8 inches, making it 15 fathoms plus 8 inches (90 feet 8 inches). The Model II-A Atlantic-Western also has 15 fathom bridles but with a top bridle of 15 fathoms one foot (91 feet). The Model IV-A-¾ has bridles of 10 fathoms; however, the top bridle is 10 fathoms plus 8 inches (60 feet 8 inches).

It is recommended that all bridles for all Atlantic-Western trawls be made evenly. The trawls should also be fished with bridles of equal length when fishing in 60 fathoms or less of water depth.

When fishing beyond 60 fathoms depth, small pieces of chain should be inserted between the headrope eyes and the top bridles to give a top bridle length that matches the plan. That is, a top bridle length of 15 fathoms 1 foot for the Atlantic-Western II-A; 15 fathom 8 inches for the Atlantic-Western IV-A; and 10 fathom 8 inches for the Atlantic-Western IV-A-¾.

Again, experience has demonstrated that this modification will improve the trawl's performances in shallow water.

IX. Rigging of the Atlantic-Western Trawls

The recommended footropes for the Atlantic-Western Trawls are chain and rubber disc configurations (Headrope and Footrope Details on pages 21, 28 and 32, Appendices C, J, and N). 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 $\frac{3}{8}$ -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 footrope 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 for 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 on pages 21, 28, and 32, Appendices C, J, and N.)

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. For example, 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 with the Atlantic-Western IV-A. 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.

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, Easley, 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 cap-

tains' endorsements, lead us to recommend that fishermen consider the trawls manufactured by this company.

The price of a completed Atlantic-Western trawl Model IV-A from Gourok-Bridport-Gundry, Ltd., assembled with all riblines hung to the headrope and bottom hanging lines, breastlines, etc., is approximately \$700. Import duties must be paid on the trawl. These duties amount to approximately \$350. Broker-

age fees and freight rates amount to approximately \$120, for a total price of approximately \$1,170. 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 \$1,400. It normally takes the company approximately three to four weeks to manufacture the trawl and ship it to the West Coast.

X. V-Cut Door Ends or Breast Lines for the Atlantic-Western Trawls

Any trawl where the door ends or wing ends are cut and hung in a straight vertical fashion will sag along the breast line or door end as the trawl is towing through the water. This results in wing web slackening back along the body of the trawl and has a slight tendency to pull the headrope down. Bottom wing webbing will also have a tendency to drag along the bottom, and small tears and holes along the bottom of the bottom wing will occur.

This situation can be relieved and bothersome small holes can be minimized by cutting a V into the wing ends so the pattern of the webbing will follow the dimensions that the trawl will take as it is being fished.

In 1973, several Atlantic-Western trawls on the Oregon coast had v cuts placed in the wings. There was no appreciable change in the catching capability of the trawl, compared to traditional trawls and also to Atlantic-Western trawls without this modification.

There was a definite decrease in the number of small tears along the bottom of the bottom wings.

This practice of cutting V's in the wing end is rapidly becoming a standard in Europe, eastern Canada, New England, and in the Pacific Northwest. It is believed that any trawl's performance can be improved by making this modification.

Detailed instructions for making the V cuts are contained in Appendices F, K, and O on pages 24, 29, and 33.

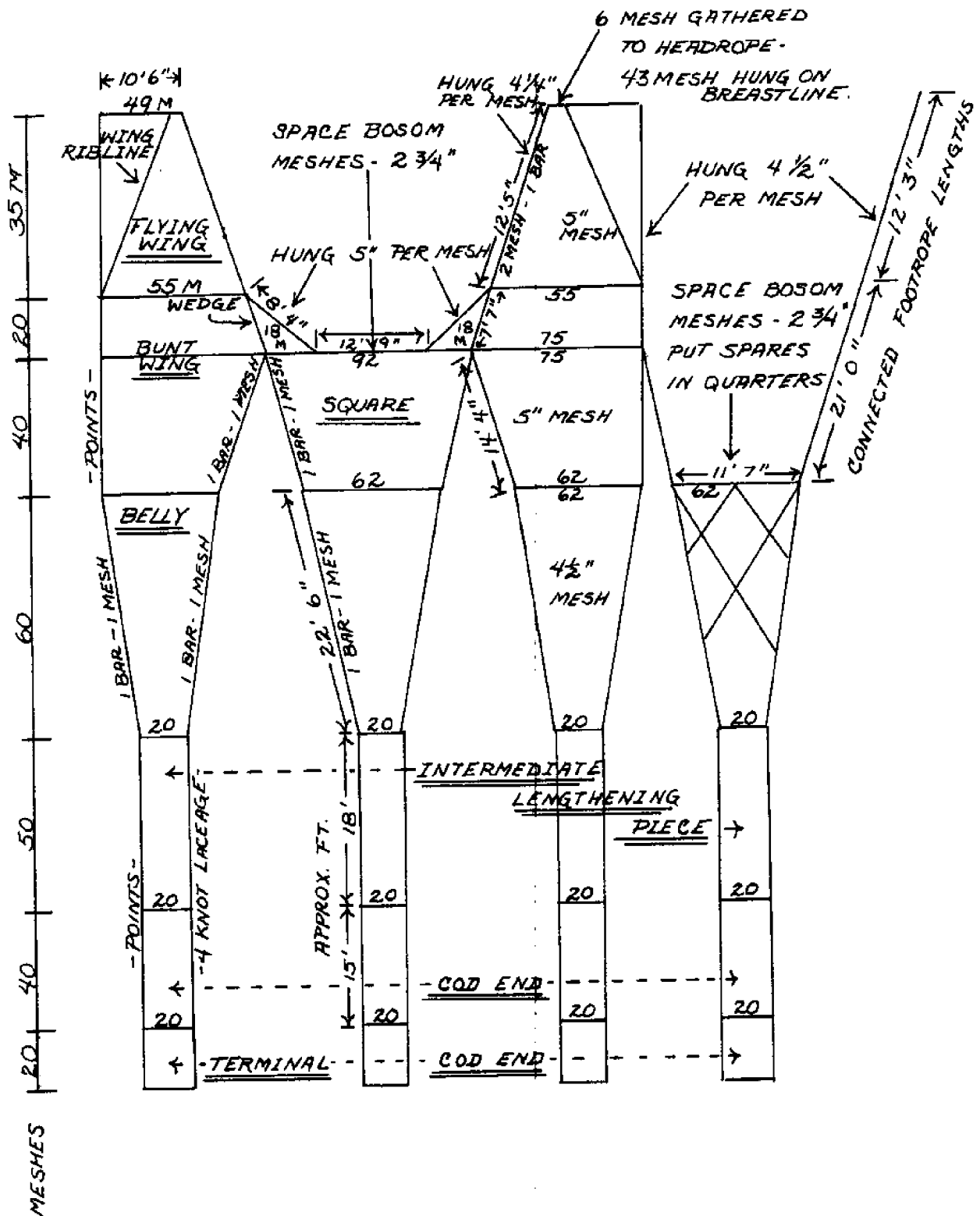
XI. Conclusion

Further information about the trawls and advice and help in rigging may be obtained from the Marine Advisory Program, Oregon State University. The superior catching capability of the trawls over a con-

siderable period of time in the commercial fisheries of Oregon has convinced me that the West Coast fishermen should consider the use of these trawls.

Appendix A

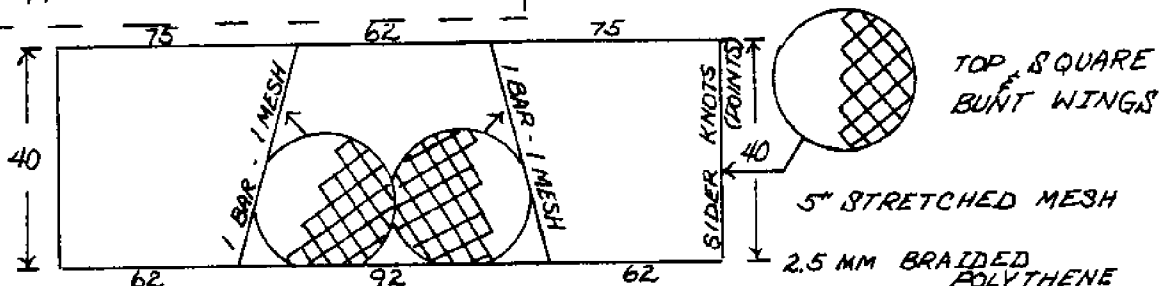
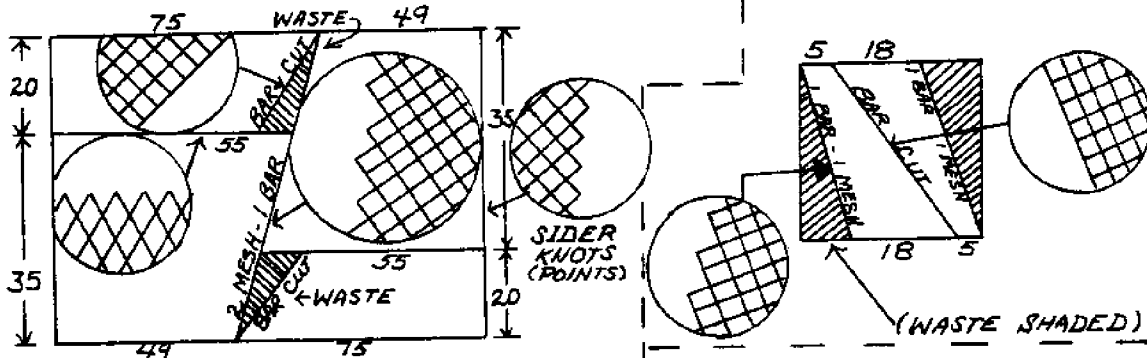
ATLANTIC WESTERN TRAWL MODEL IVA



Appendix B

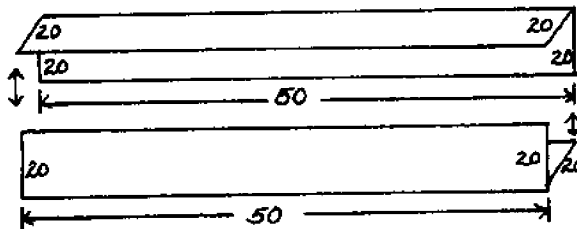
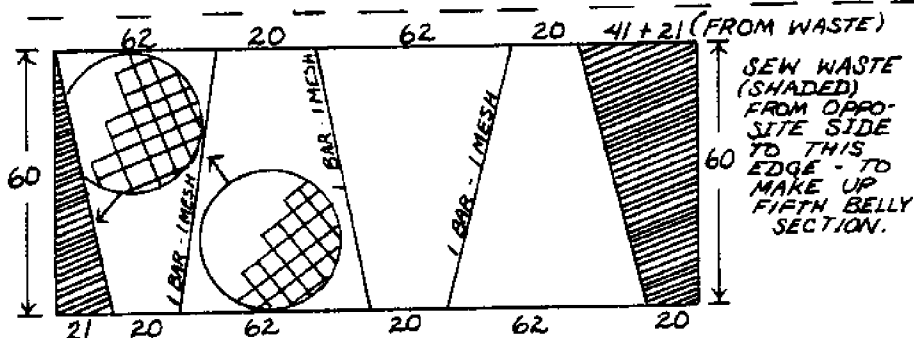
WINGS & FLYING WINGS
5" STRETCHED MESH 2.5 MM BRAIDED POLYTHENE.

WEDGES
5" STRETCHED MESH



BELLY

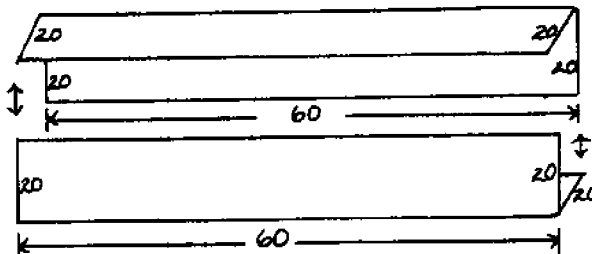
4 1/2" STRETCHED MESH.
BELLIES TO BE OF
2.5 MM BRAIDED
POLYTHENE.



LENGTHENING PIECE

4 1/2" STRETCHED MESH
GATHER 3 KNOTS FROM EACH PANEL
EDGE TO MAKE FOUR LACEAGES EACH.
LENGTHENING PIECE OF 3.0 MM DOUBLE
BRAIDED POLYTHENE.

COD END
4 1/2" STRETCHED MESH
GATHER 3 KNOTS FROM EACH
PANEL EDGE - AS IN LENGTHENING
PIECE.
COD END TO BE OF 120 THREAD
NYLON OR 4.5 MM DOUBLE
BRAIDED POLYTHENE.



CUTTING AND TAPERS

NOTE: 1 MESH ALLOWED FOR EVERY TAPER.

ATLANTIC WESTERN TRAWL

MODEL
IV A

Appendix C

HEADROPE AND FOOTROPE DETAILS MODEL IVA

HEADROPE: 54' 3" MADE IN 3 PIECES - 12' 5" + 29' 5" + 12' 5" $\frac{3}{4}$ " DIAMETER COMBINATION ROPE

FOOTROPE: 78' 1"

RUBBER DISC TYPE: WING - 33' 3" - $\frac{3}{8}$ " DIAMETER CHAIN + BOSOM 11' 7" $\frac{1}{2}$ " CHAIN + WING 33' 3" $\frac{3}{8}$ " DIAMETER CHAIN

ROLLER OR BOBBIN TYPE: - $\frac{1}{2}$ " 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.

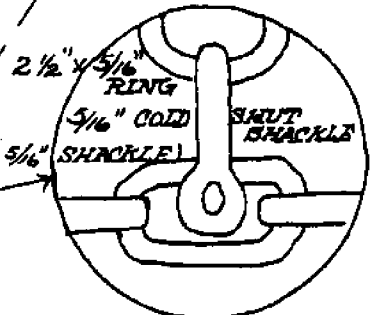
NOTE: ALL FOOTROPES TO BE 78' 1"

FLOATS: STANDARD 6" DIAMETER TRAWL FLOATS.

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

ROLLER OR BOBBIN FOOTROPE.

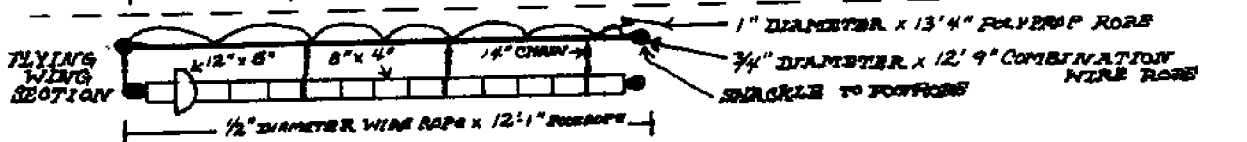
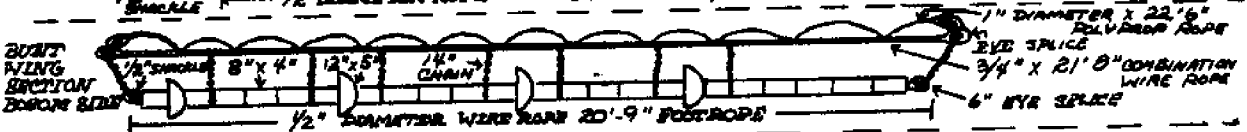
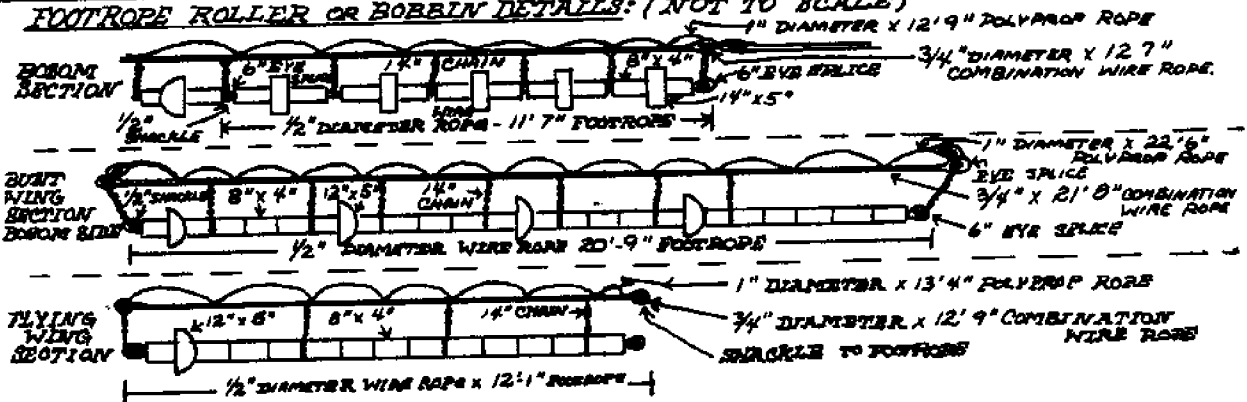
38 - 45 FLOATS DEPENDING ON BOTTOM



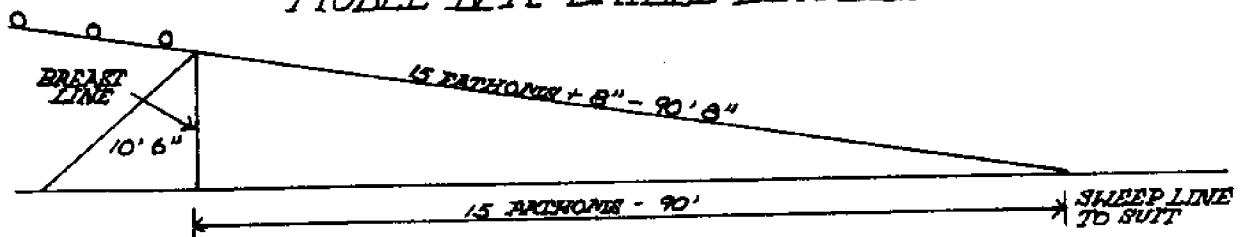
FOOTROPE CHAIN DETAILS:



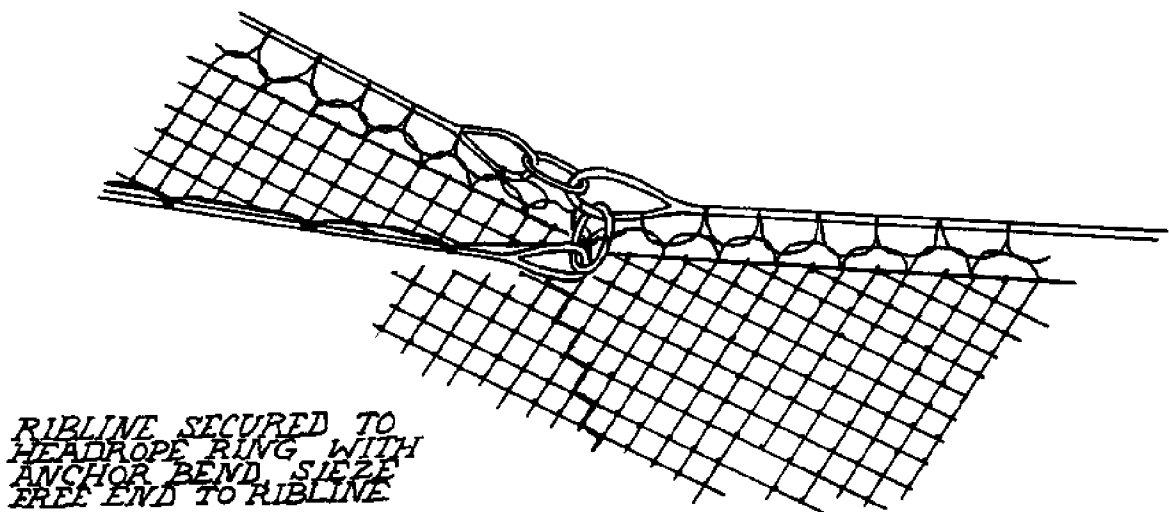
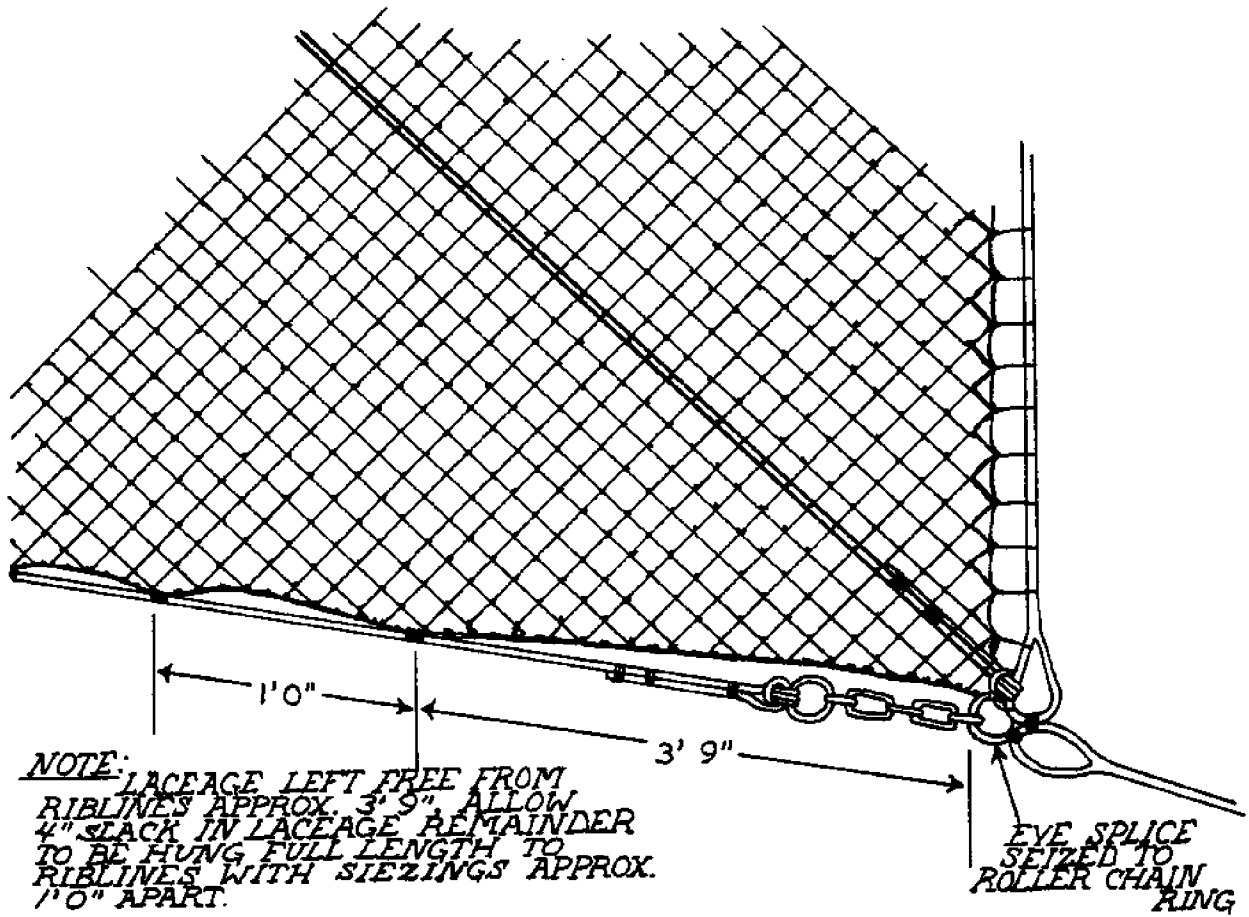
FOOTROPE ROLLER OR BOBBIN DETAILS: (NOT TO SCALE)



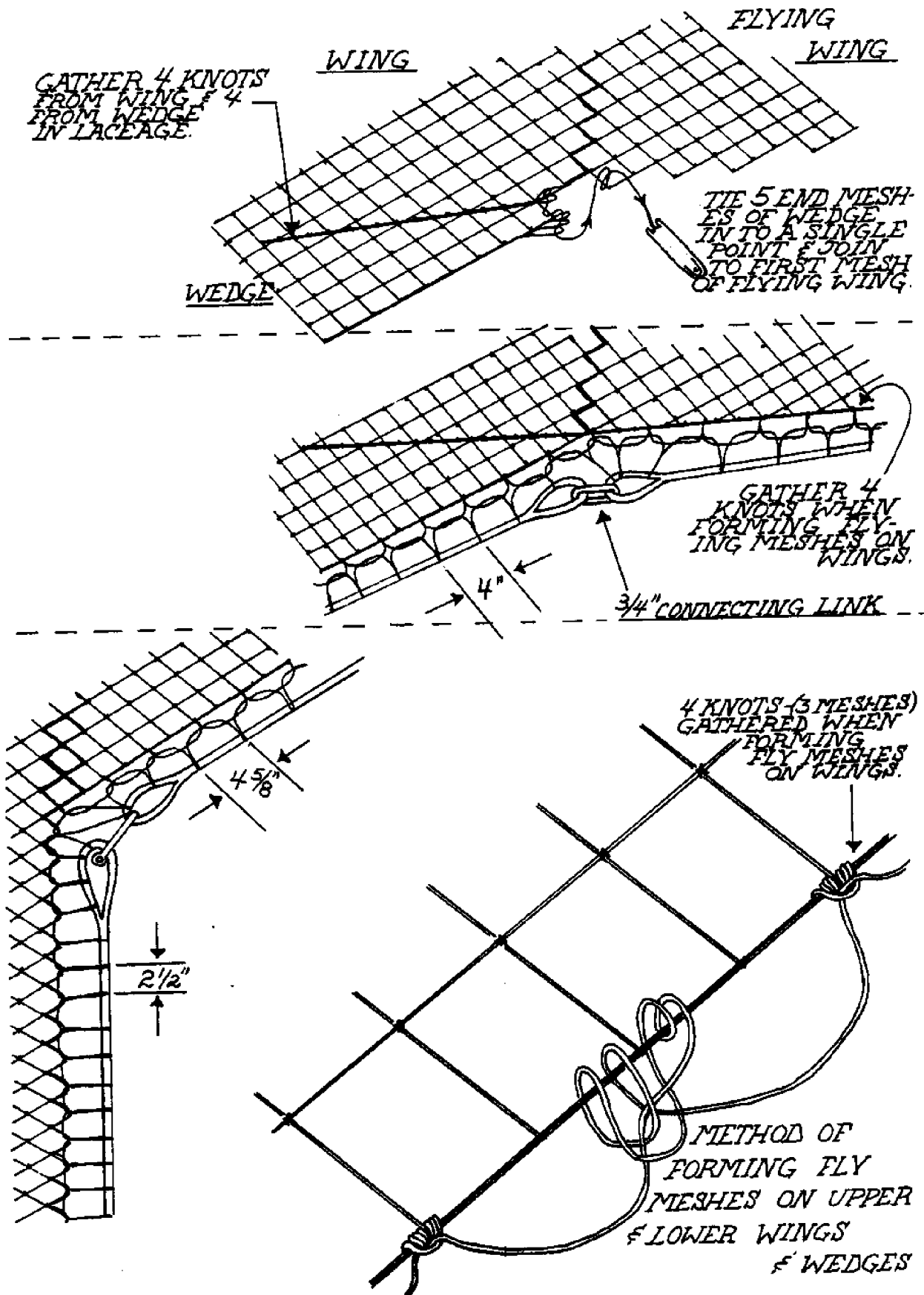
MODEL IVA - BRIDLE DETAILS



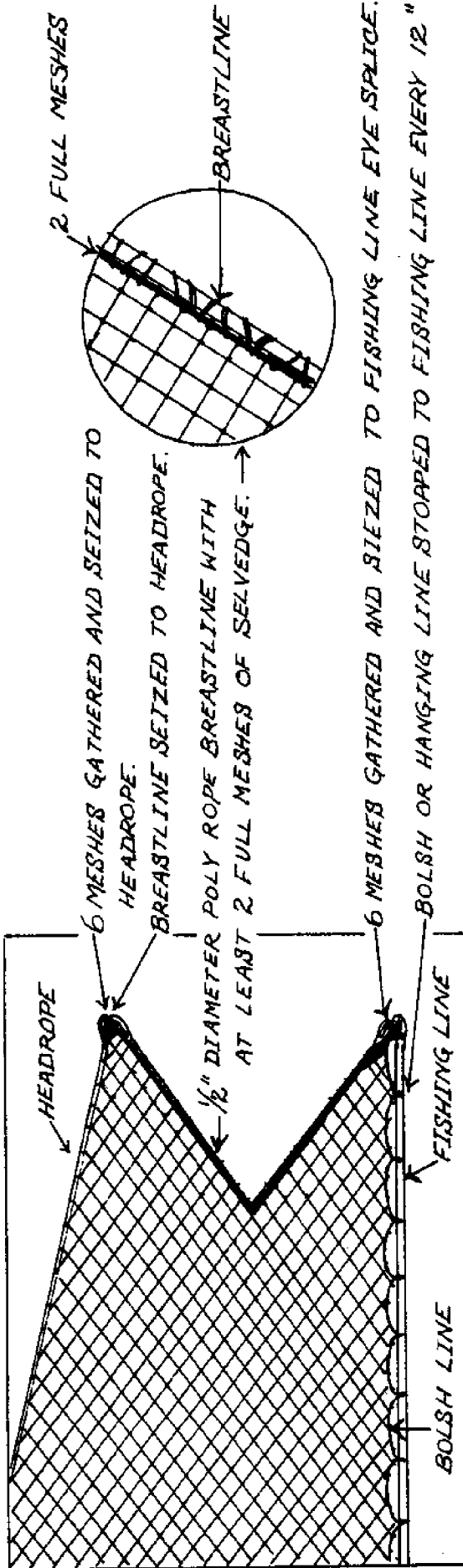
Appendix D



Appendix E



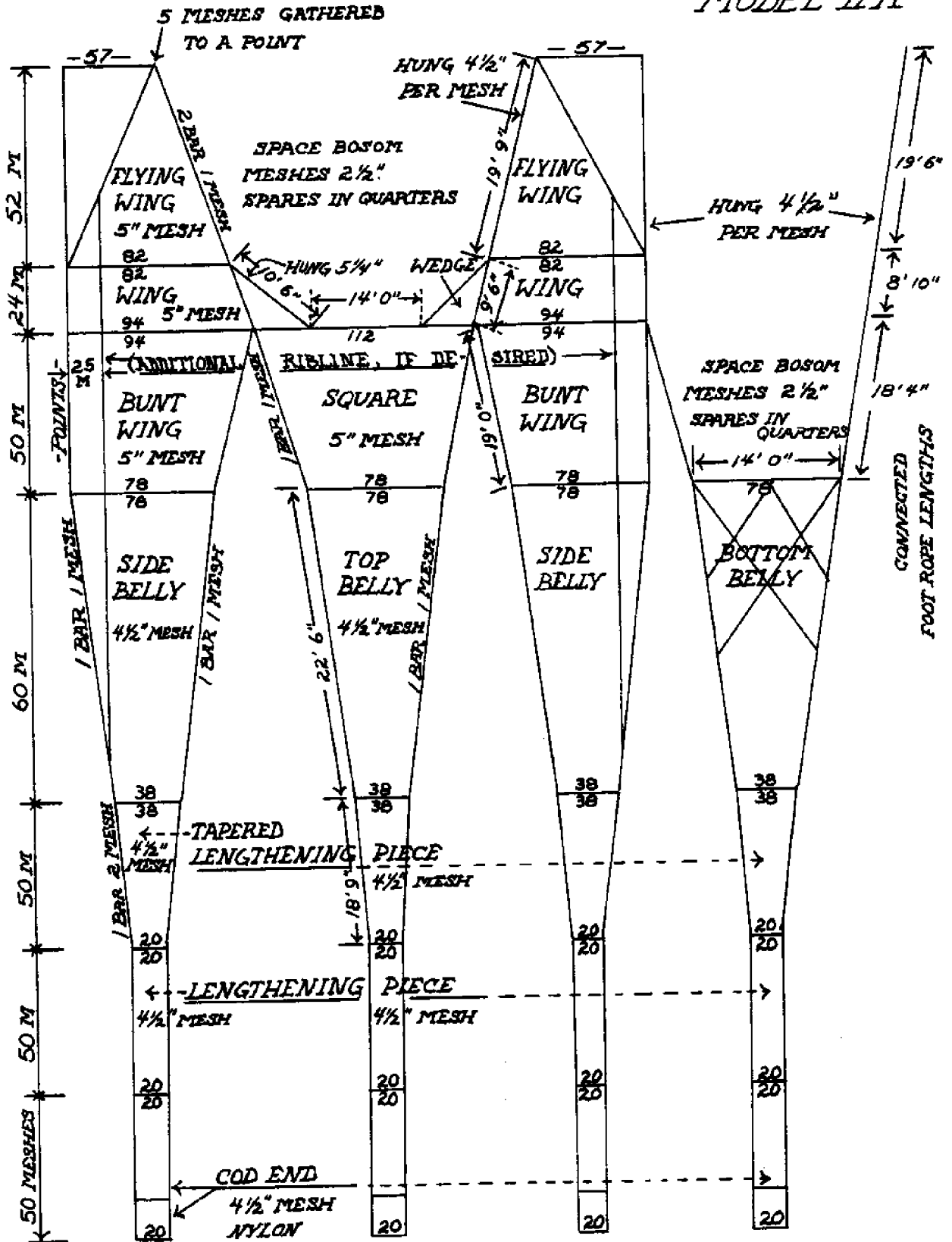
V-WING CUTTING DIAGRAM
AND RIGGING INSTRUCTIONS
FOR
MODEL IV A TRAWL



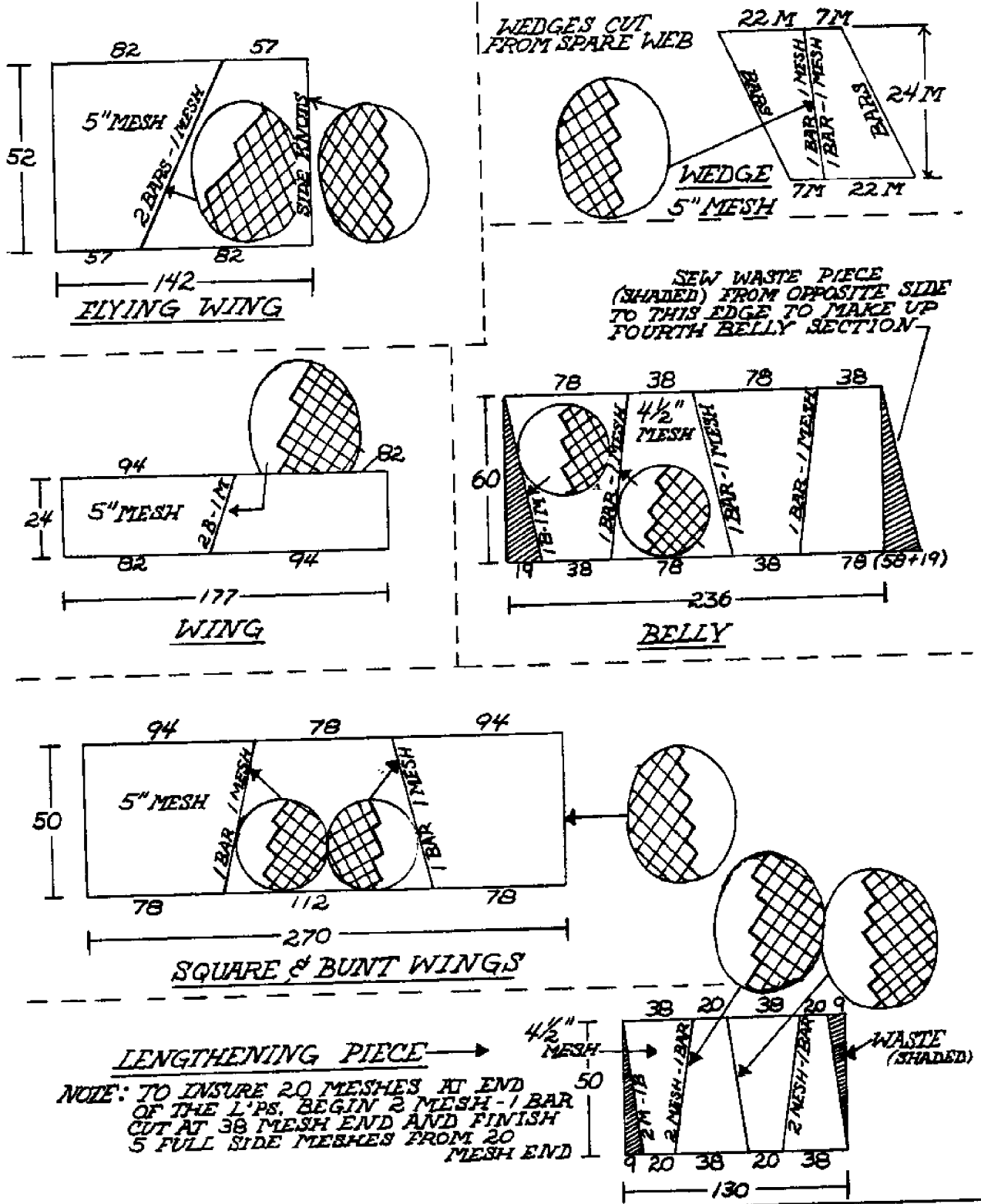
1. COUNT OFF 6 MESHES DOWN FROM TOP OF THE WING PANEL AT THE HEADROPE. CUT DOWN INTO THE WING ON A STRAIGHT BAR CUT FROM THE SIXTH MESH FOR 18 FULL MESHES, OR UNTIL THE MIDWING PORTION IS REACHED.
2. COUNT OFF 6 MESHES UP FROM THE BOTTOM OF THE WING PANEL AT THE HANGING LINE. CUT UP INTO THE WING ON A STRAIGHT BAR CUT FROM THE SIXTH MESH FOR 18 FULL MESHES OR UNTIL THE MIDWING PORTION IS REACHED.
3. GATHER THREE KNOTS OF WEB, (2 FULL MESHES), ON EACH BAR CUT AND SELVEDGE A $\frac{1}{2}$ " DIAMETER POLY ROPE BREASTLINE TO THE WEBBING LYE SPLICE THE BREASTLINE ENDS AND SIEZE TO THE HEADROPE AND FISHING LINE EYE SPLICES.

Appendix G

ATLANTIC WESTERN TRAWL MODEL IIA



Appendix H



CUTTING AND TAPERS

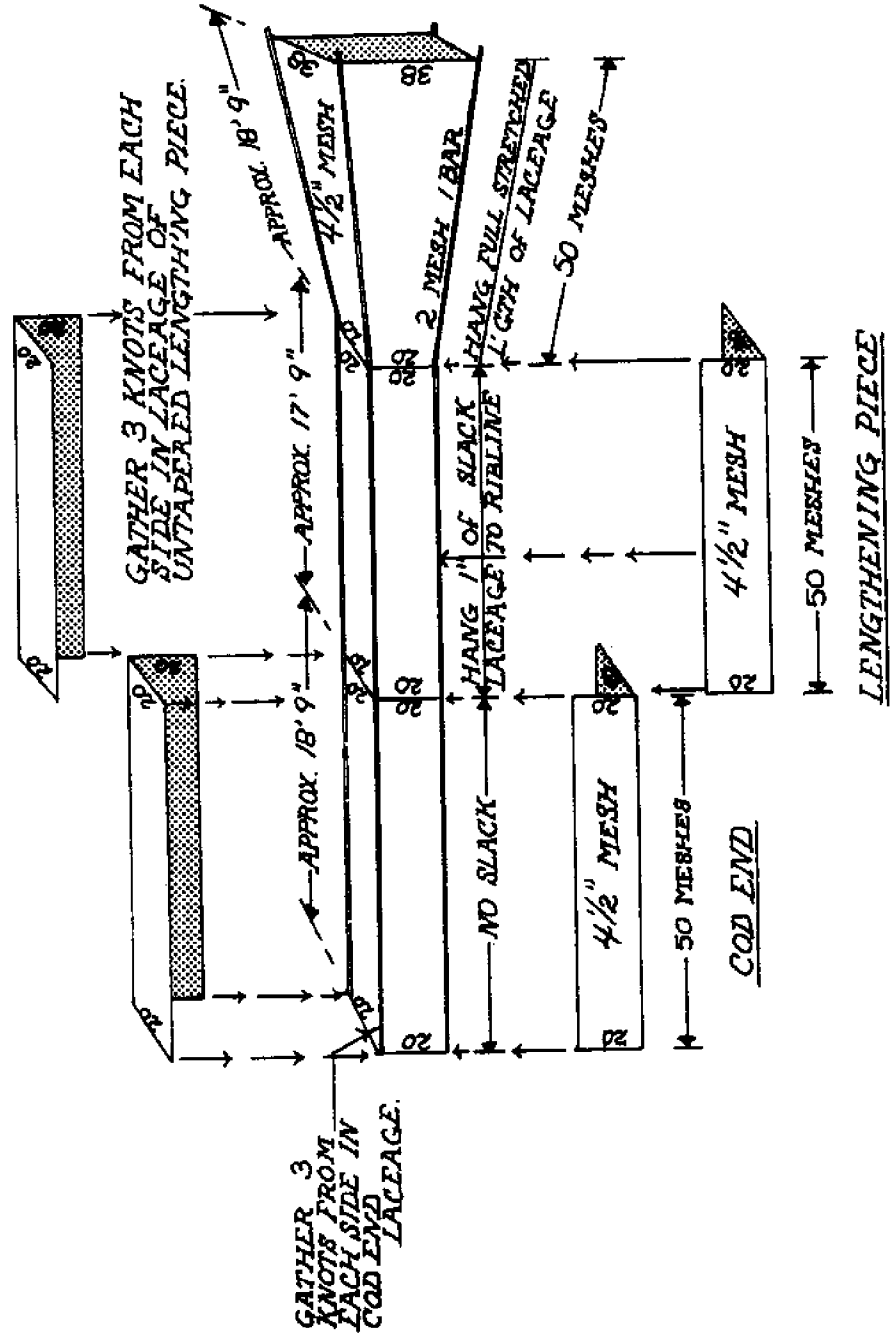
NOTE: 1 MESH ALLOWED FOR EVERY TAPER.

ATLANTIC WESTERN TRAWL
 MODEL IIA

Appendix I

GATHER 4 KNOTS FROM EACH SIDE IN LACEAGE OF TAPERED LENGTHENING PIECE.

RIBLINES ATTACHED TO LENGTHENING PIECES WITH SEIZINGS APPROX 1/0" APART TO COD END WITH A HITCH EVERY MESH.



COD END AND LENGTHENING PIECE DETAILS ATLANTIC WESTERN TRAWL MODEL IIA

Appendix J

HEADROPE AND FOOTROPE DETAILS MODEL IIA

HEADROPE- 74'6" MADE IN 5 PIECES- 19'9" + 10'6" + 14'0" + 10'16" + 19'9"
3/4" COMBINATION ROPE.

FOOTROPE- 107'4"
RUBBER DISC TYPE:- WING- 46'8" 1/2" DIAMETER CHAIN + BOSOM 18'6" 3/4" DIAMETER CHAIN + WING 46'8" 1/2" DIAMETER CHAIN.

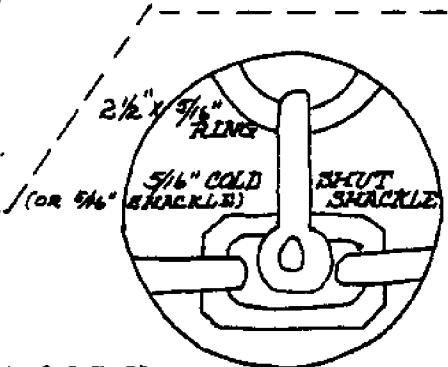
ROLLER OR BOBBIN TYPE:- 5/8" DIAMETER WIRE ROPE- MADE IN 7 PIECES-
19'0" + 8'8" + 18'2" + 13'6" + 18'2" + 8'8" + 19'0"
(WHEN SPACKLED TO EQUAL 107'4")

BOSOM SECTION OF BOBBINS CAN BE COMBINED WITH WING SECTIONS OF RUBBER DISC.
NOTE: ALL FOOTROPES TO BE 107'4"

FLOATS: STANDARD- 6" 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.

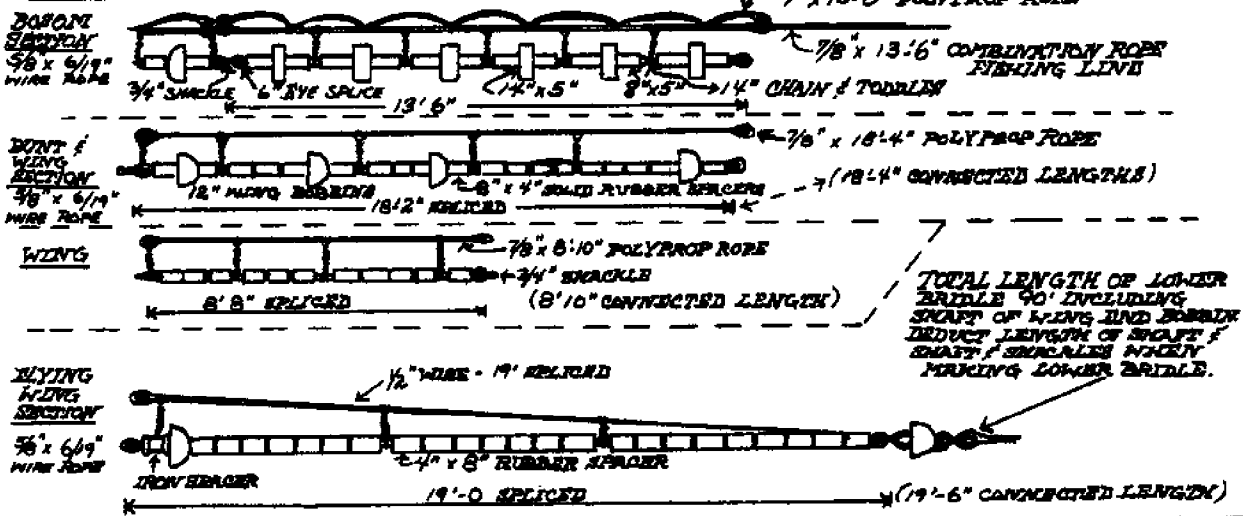


FOOTROPE CHAIN DETAILS:

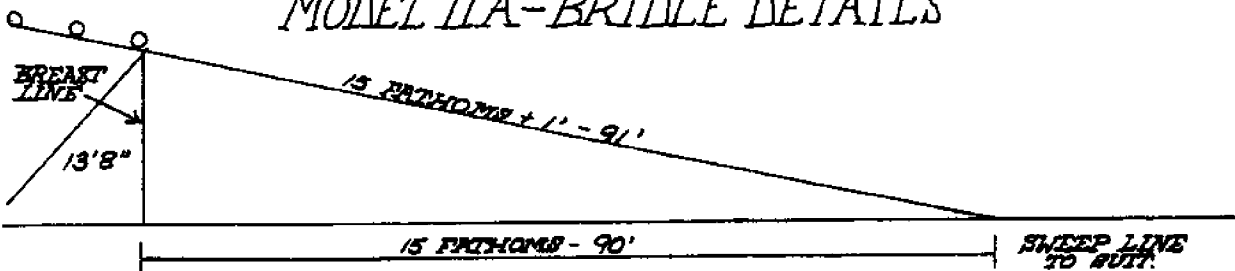
THROAT OR BOSOM
10" of 4 1/2" DIAMETER RUBBER DISCS- HUNG IN 12" of CHAIN.

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

FOOTROPE ROLLER OR BOBBIN DETAILS: (NOT TO SCALE)

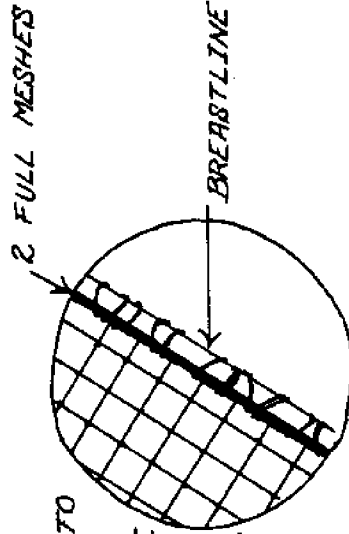
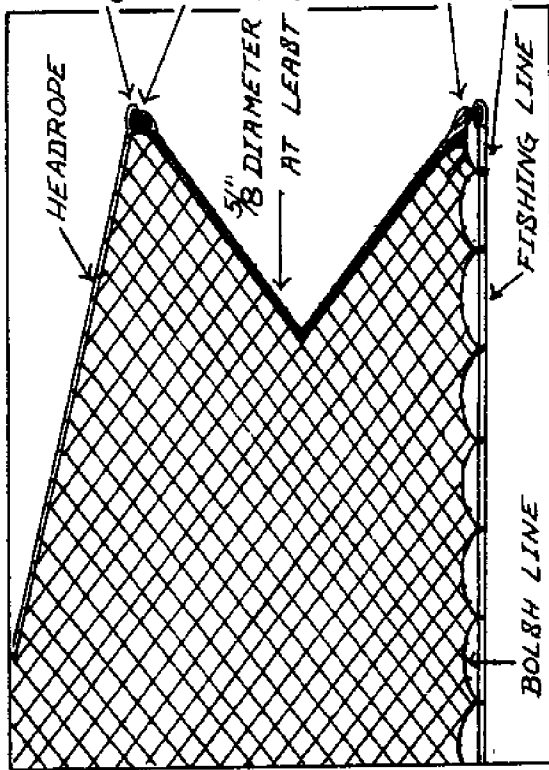


MODEL IIA-BRIDLE DETAILS



Appendix K

V-WING CUTTING DIAGRAM AND RIGGING INSTRUCTIONS FOR MODEL IIA TRAWL



8 MESHES GATHERED AND SEIZED TO HEADROPE.

BREASTLINE SEIZED TO HEADROPE.

5/8" DIAMETER POLY ROPE BREASTLINE WITH AT LEAST 2 FULL MESHES OF SELVEDGE.

8 MESHES GATHERED AND SEIZED TO FISHING LINE EYE SPLICE.

BOLSH OR HANGING LINE STOPPED TO FISHING LINE EVERY 12".

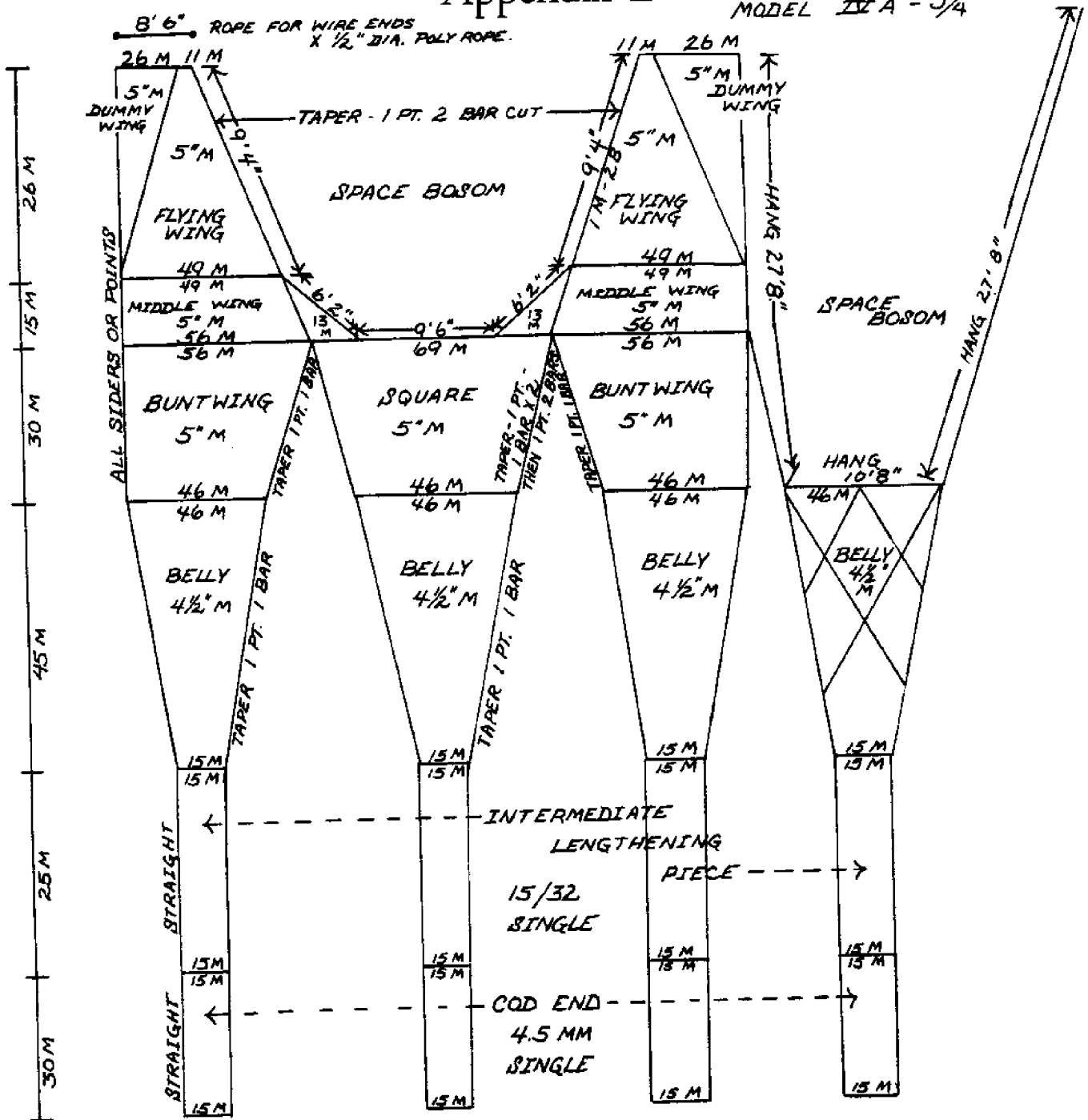
1. COUNT OFF 8 MESHES DOWN FROM TOP OF THE WING PANEL AT THE HEADROPE. CUT DOWN INTO THE WING ON A STRAIGHT BAR CUT FROM THE EIGHTH MESH FOR 21 FULL MESHES, OR UNTIL THE MIDWING PORTION IS REACHED.

2. COUNT OFF 8 MESHES UP FROM THE BOTTOM OF THE WING PANEL AT THE HANGING LINE. CUT UP INTO THE WING ON A STRAIGHT BAR CUT FROM THE EIGHTH MESH FOR 21 FULL MESHES OR UNTIL THE MIDWING PORTION IS REACHED.

3. GATHER THREE KNOTS OF WEB (2 FULL MESHES), ON EACH BAR CUT AND SELVEDGE A 5/8" DIAMETER POLY ROPE BREASTLINE TO THE WEBBING. EYE SPLICE THE BREASTLINE ENDS AND SEIZE TO THE HEADROPE AND FISHING LINE EYE SPLICES.

Appendix L

MODEL IV A - 3/4



MESHES

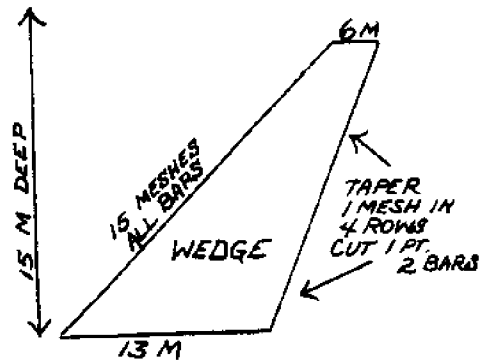
— FISHING LINE x 5/8" DIA. POLY ROPE:

3 PIECES - 1 PIECE - 10' 8"
2 PIECES - EA. 27' 8"

— BOLS H LINE x 3/8" DIA. POLY ROPE:

3 PIECES - 1 PIECE - 10'
2 PIECES - EA. 27'

— RIBLINE TO BE MADE FROM 5/8" OR 1/2" DIA. POLY ROPE.

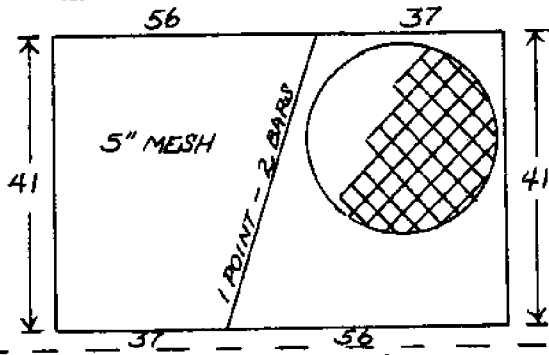


Appendix M

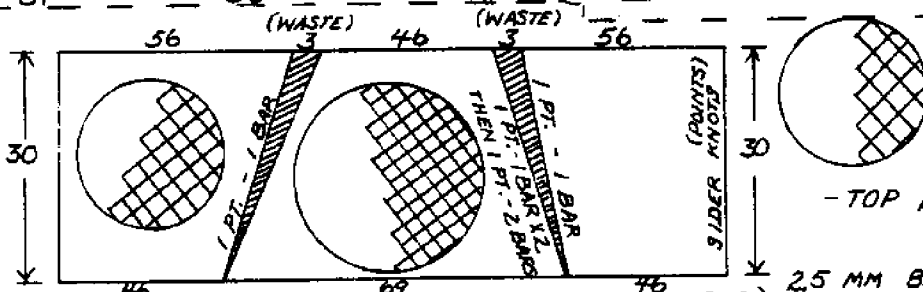
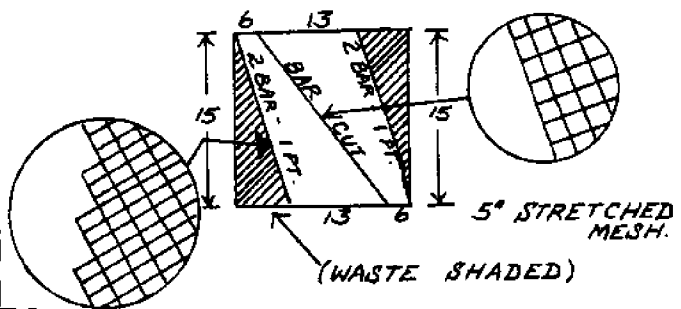
MODEL IVA-3/4

- WINGS & FLYING WINGS -

2.5 MM BRAIDED POLYTHENE TWINE.



- WEDGES -



(NOTE: ALLOW 1 MESH CUT OR WASTE FROM EACH TAPER.)

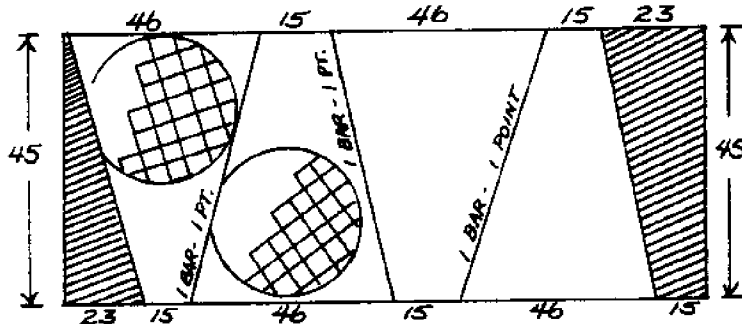
- TOP SQUARE & BUNT WING -

2.5 MM BRAIDED POLYTHENE.
5" STRETCHED MESH

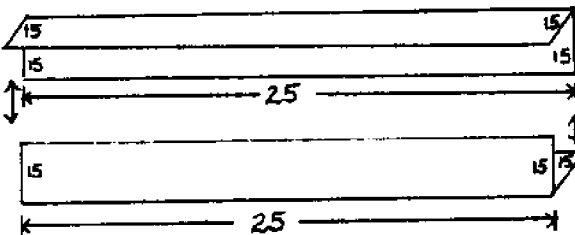
- BELLY -

4 1/2" STRETCHED MESH

BELLIES TO BE OF
2.5 MM BRAIDED
POLYTHENE.



SEW WASTE (SHADED)
FROM OPPOSITE
SIDE TO THIS
EDGE TO
MAKE UP
FIFTH BELLY
SECTION.



- LENGTHENING PIECE -

4 1/2" STRETCHED MESH

GATHER 3 KNOTS FROM EACH PANEL
EDGE TO MAKE FOUR LACEAGES EACH.

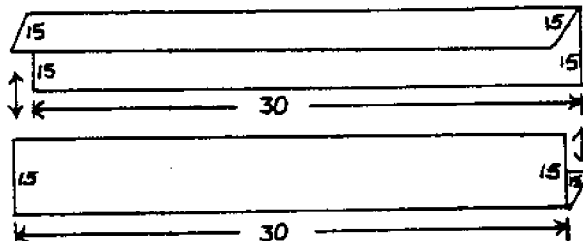
LENGTHENING PIECE OF 15/32 SINGLE
BRAIDED POLYTHENE.

- COD END -

4 1/2" STRETCHED MESH

GATHER 3 KNOTS FROM EACH
PANEL EDGE AS IN LENGTHENING
PIECE.

COD END TO BE OF 64 THREAD
NYLON OR 4.5 MM SINGLE
BRAIDED POLYTHENE.



- CUTTING AND TAPERS -

NOTE: 1 MESH ALLOWED FOR EVERY TAPER OR CUT.

ATLANTIC WESTERN TRAWL - MODEL IVA-3/4

Appendix N

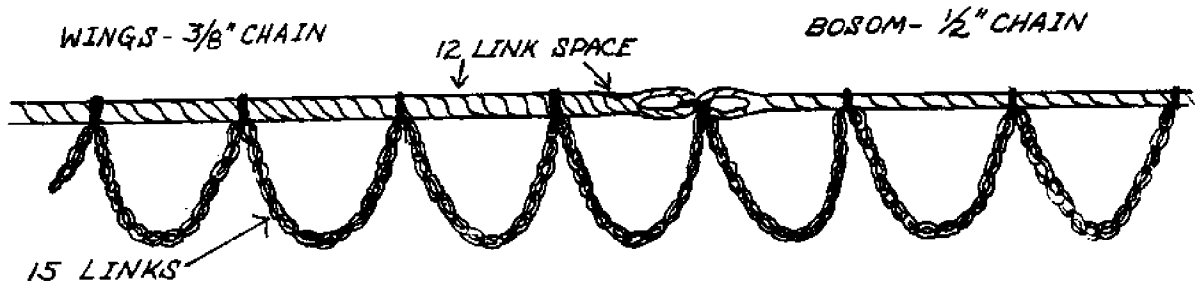
HEADROPE AND FOOTROPE DETAILS MODEL IVA - 3/4

HEADROPE: 40'-6". MADE IN 3 PIECES - 9'-4", + 21'-10", + 9'-4". JOIN TOGETHER.
 3/4" DIAMETER POLYPROPYLENE ROPE OR 1/2" DIA. COMBINATION WIRE ROPE.

FOOTROPE: 64' - MADE IN 3 PIECES - ALL FOOTROPE TYPES.
 RUBBER DISC TYPE: WING - 27' - 3/8" DIA. CHAIN + BOSOM 10'.
 1/2" CHAIN + WING 27'. 3/8" DIAMETER CHAIN: EQUALS 64'.

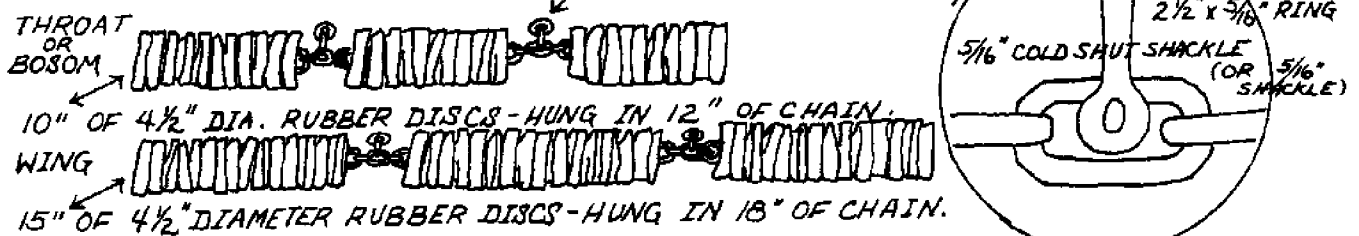
ROPE AND CHAIN TYPE FOOTROPE:

3/4" POLYPROPYLENE ROPE IN 3 PIECES: WING - 27' AND BOSOM - 10' - AND WING OF 27', EQUALS 64'. SEIZE OR SHACKLE EYE SPLICES TOGETHER. HANG CHAIN (15 LINKS) INTO A SPACE OF 12 LINKS EVENLY ALONG ENTIRE FOOTROPE. SEIZE CHAIN LINKS SECURELY WITH HEAVY TWINE STOPS. USE 3/8" DIA. CHAIN ON WINGS AND 1/2" CHAIN ON BOSOM.

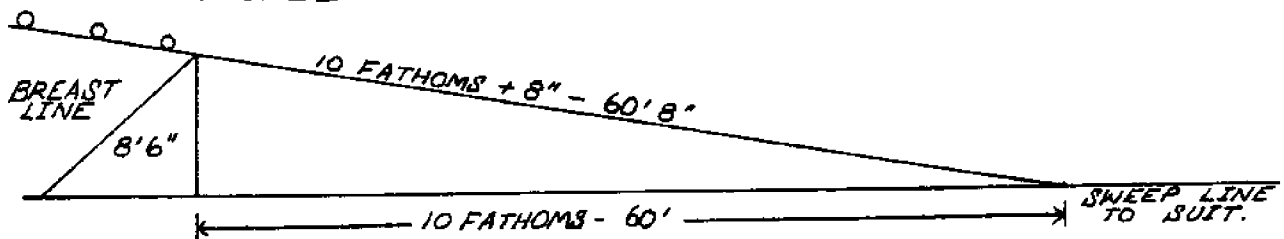


RUBBER DISC-ROPE AND CHAIN COMBINATION FOOTROPE CAN BE MADE UP WITH 27' ROPE AND CHAIN FOR EACH WING AND A 10' RUBBER DISC BOSOM SECTION: EQUALS 64'.

FOOTROPE CHAIN DETAILS - RUBBER DISC TYPE:



MODEL IVA 3/4 - BRIDLE DETAILS



NOTE: IN LESS THAN 50 FATHOMS DEPTH - MAKE BRIDLES EQUAL LENGTH.

