Telescope

25¢

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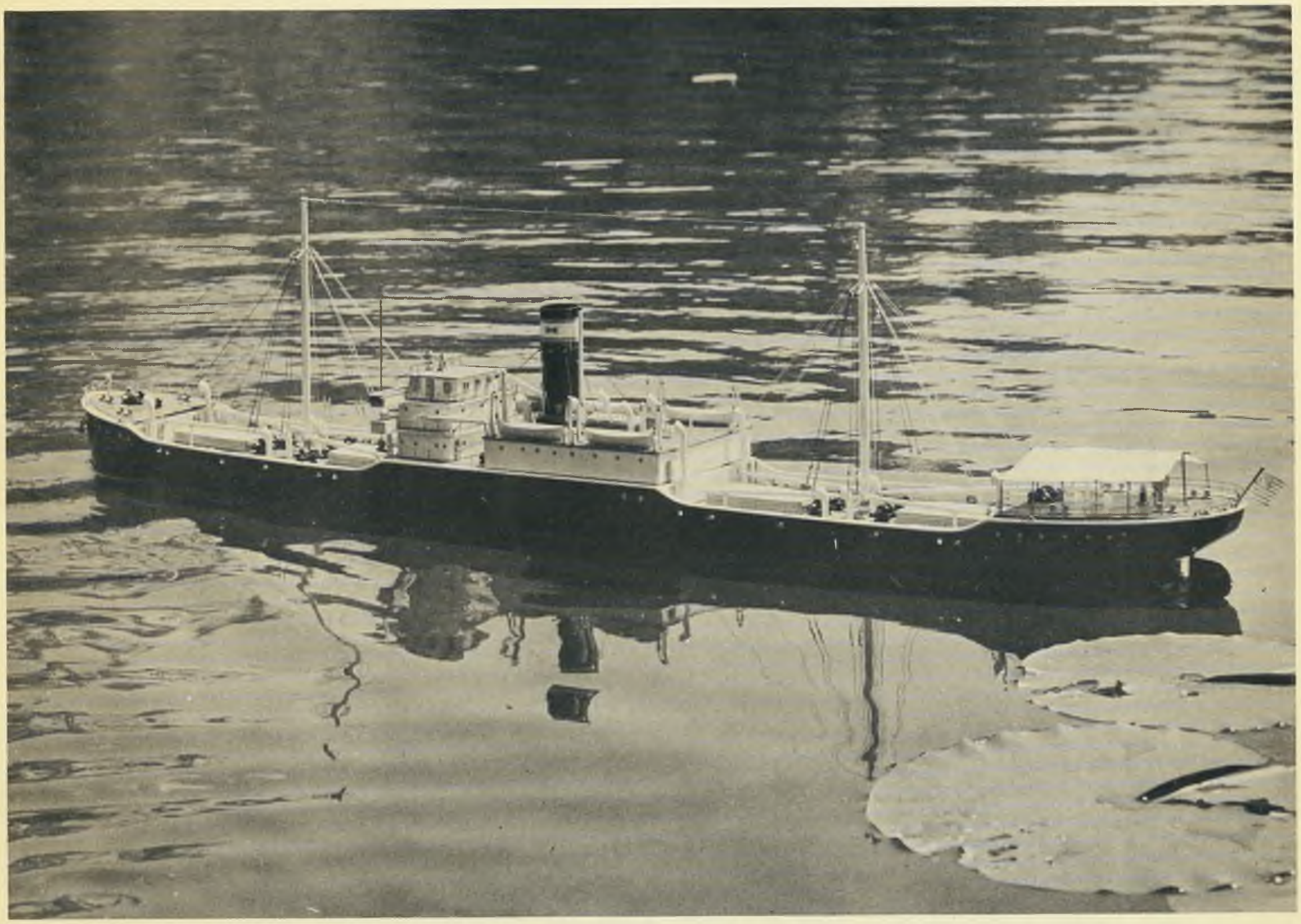

Self-propelled model of a Hog Island type freight vessel "JO ME LIS", built by Charles S. Mooney

Telescope

J. E. Johnston, Editor
MEMBERSHIP $3.00

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EDITORIAL

THE END OF THE BEGINNING

By the time this number of TELESCOPE reaches you there will have been an official announcement, by the Detroit Historical Commission, of the coming abandonment of the schooner "J.T.Wing" as a home for the Museum of Great Lakes History.

This is not the beginning of the end, but merely the end of a very good beginning. For six years the ship has been her own billboard. At first she was the major part of the museum. Gradually our collections have grown and now they constitute values which can not be ignored. They must be adequately and safely housed so that posterity will have the benefit of the countless hours of research by the hundreds of persons who have contributed towards the preservation of the story of the development of commercial shipping on these Great Lakes.

The good old ship, a present from Grant H.Piggott, of the J.T.Wing Company, and Joseph Braun, of the Braun Lumber Company, to the City of Detroit, has come to the end of her last voyage;---a six-year voyage into the past. She comes in "full and by", which is to say in old nautical language, full to the last cubic foot and down to her marks. The term means that the vessel is loaded in a manner which will bring the greatest possible revenue, or returns. We believe this is true at this time. We regret her passing, but wind and weather and dryrot have taken their tolls.

Most of us can remember her last voyage on the Detroit River, from 24th Street dock to Belle Isle. It was a glorious day, with a fresh N.W. breeze whipping up whitecaps, and the sky filled with wool-pack clouds resembling nothing so much as the ghosts of that vast armada of sail gone on before,--the Griffin, Nancy, Challenge, James F.Joy, Lucia Simpson, Milton, and all the others, back again, in the spirit, to convoy to her last resting place the last of their kind, though her keel was alien to these waters.

And now? Those ghost-ships have returned to life, reduced somewhat in size, but not in detail. They live on in model form, and shall live, if protected, to tell the tale of one of America's most thrilling achievements, Great Lakes Shipping. We turn now to the job of providing that protection. Our members, subscribers, and the public are invited to help.

SUPPRESSION OF SHIP VIBRATION BY FLOW CONTROL

L.A. Baier, Professor and Chairman Dept. of Naval Architecture and Marine Engineering University of Michigan.
Jesse Ormondroyd, Professor of Engineering Mechanics University of Michigan.

SUMMARY

A survey of the probable causes of a peculiar type of vibration frequently occurring at the stern of ships, together with a review of hull vibration, is presented in a non-mathematical manner. A study of flow conditions in the vicinity of the propeller was undertaken by the use of self-propelled models in the circulating water tank at the David Taylor Model Basin, Carderock, Maryland.

A simple non-mechanical flow control device was designed by the authors and to date has been installed on some 22 vessels with uniform success in the practical elimination of stern vibration.

SHIP VIBRATION

In the design of a ship the naval architect is concerned with a large mass which is self supporting in a fluid subject to dynamic forces and propelled through this medium by the conversion of torque into thrust. The movement of this mass and the creation of thrust likewise introduce hydrodynamic and physical influences which frequently develop serious problems. One consequence of particular complexity is the phenomenon of hull vibration. Such a condition is often of considerable discomfort to the operating personnel and induces structural failures through material fatigue.

The more common sources of vibration are unbalanced rotating parts of the propulsion machinery, shafting or propellers; torsional criticals; wave impacts; hull and propeller cavitation. The resulting hull vibrations may be typed as torsional, horizontal linear or vertical linear. in the propeller-shaft-machinery system vibrations may be identified as linear in the longitudinal direction of the shaft; and torsional. These types of ship vibration have been the subject of numerous theoretical and experimental investigations. A rather complete bibliography for this field of study is given of page 14 of Reference (5). It may be of interest to outline the general problem of ship vibration with some further detail.

Two fundamentally different kinds of vibration can arise from the rotation of the propulsion machinery in a ship. The first of these comes from mechanical unbalance in the rotating units. If the propeller shaft is bent or the propeller blades damaged, or statically or dynamically unbalanced, a disturbance with a frequency of once per propeller revolution acts on the ship. This can manifest itself in vertical or lateral hull vibration. In multi-propellered ships, where all the wheels are off the fore and aft center line, this unbalance disturbance can give rise to torsional vibration of the hull. Unbalance also can excite bending shirling of the propeller shafting.

Hull and shaft vibrations caused by unbalance remain relatively unimportant unless the rotational frequency coincides with a natural frequency of the hull (vertical, lateral or torsional), or a natural whirling torsional or fore and aft frequency of the propeller shafting. When the coincidence of rotational frequency and natural frequency occurs (resonance) large vibration amplitudes result, being very obvious to the senses and often destructive to the hull, shafting and bearings. The cure for vibration arising from unbalance is naturally to remove the unbalance.

The second type of vibration which is frequently found on ships is not so easily understood and because of this, not so easily remidied. This type arises from the interaction of the propeller and the water in which it operates. It is identified by the fact that its frequency in cycles per minute is equal to the number of propeller blades times the rpm of the wheel; or integer multiples of this combination. It is a hydrodynamic phenomenon, the details of which have not been completely determined.

The fundamental situation is readily understandable. When a propeller operates in a radially uniform or symmetrical flow of water it produces a low pressure region forward of the propeller disk and a high pressure region aft of the disk. The difference in pressure acting on the projected area of the blades produces the thrust which moves the ship through the water. Even in this ideal situation the pressure field in line with the projected area of the blades must differ from the pressure field in line with the gaps between the blades. The hull of the ship forward of the wheel can feel this difference in pressure during the rotation of the propeller. Ideally, the propeller itself would experience only constant thrust and torque with completely balanced radial forces.

But the actual propeller behind the ship does not operate in a radially symmetrical flow into its forward face. The presence of the hull, bossings or struts ahead of the wheel distort the oncoming flow in many ways. The wake fraction of the water flowing into the forward face of the wheel varies widely in magnitude and direction. The rotation of the propeller adds to the complication in the feed water wake distribution. In general there result from this two factors: First, a highly variable pressure field in the water ahead of and aft of the wheel; and second, variable radial and longitudinal forces on the propeller itself.

The general situation is readily seen, but the exact magnitudes of the pressure variations in the water and the force variations still are unknown except by inference drawn from the results of vibration measurements made on the ship structure. Direct measurements of the pressure of the water surrounding the propeller attached to a ship have never been made. Nor has any propeller in a ship been mounted in a universal dynamometer which could measure directly the forces and moments acting on the wheel.

The consequences of these variable hydrodynamic forces and moments are longitudinal, torsional and bending vibrations on the propeller shafting, and vertical, lateral and torsional vibration of the hull.

While most of the destructive torsional vibration in propeller shafting experienced on a ship is excited by the reciprocating drives, some propeller shaft failures in turbine driven vessels have been ascribed to combinations of bending and torsional disturbances arising in the propeller operation, (2). Longitudinal vibrations of propeller shafting and machinery is a common problem in ships with relatively long shafting systems. Most vertical hull vibrations and some horizontal hull vibrations have definitely been caused by the hydrodynamic action of the propeller. In multi-screwed vessels torsional hull vibration at propeller blade frequency could be excited in this manner.

In the case of longitudinal, lateral and torsional vibrations in the propeller shafting and machinery no serious problems arise unless resonance in these various modes of vibration are encountered. When these resonances occur at the normal operating speed of the ship an effective solution is to change the number of propeller blades, in order that the same resonances occur at speeds above or below the normal operating ship speed and rpm. When vertical, lateral or torsional hull resonances occur at the normal operating speed the same remedy is effective. There is, however, one problem in hull vibration which cannot be cured by changing the number of blades----and that is the problem of fantail vibration. This is a very common problem in all classes of ships. In this type of vibration all the noticeable vibration occurs aft of the after quarter length of the ship. The ship hull forward of this point is either not vibrating at all, or vibrates only slightly. This phenomenon has recently been explained by considering the ship as a beam, vibrating under the action of the propeller-excited hydrodynamic forces. The ship has several natural modes of vertical, lateral and torsional vibration. In the case of vertical vibration many ships have normal operating speeds where the frequency of propeller blade excitation is above all the excitable vertical modes of hull vibration. In this case all the modes are excited in non-resonate motion, but the modes all add in phase near the propeller location and are in such phase forward of the after quarter point as to cancel each other out. Figure 1 shows the combination for a particular ship producing this type of fantail vibration. There is no way to cure the trouble, either by changing the number of blades or by adding additional steel locally to the hull. The only method by which this trouble can be alleviated is to eliminate the variable exciting forces at the propeller. This has been accomplished by providing the wheel with a more uniform flow of water into its forward face. Several means of doint this are given in detail. If the flow is made completely uniform in the feed water flow then all the vibration in shafting and hull will be eliminated.

THE SOURCE OF STERN VIBRATION

The unique type of vibration frequently experienced by high powered vessels, which is concentrated at the stern, has long baffled naval architects and authorities in the field of fluid mechanics. Attention was focussed on this problem in Great Lakes vessels during the past two years due to the recent economic demand for higher ship speeds. Age and obsolescence required repowering on several ore carriers, and propulsion plants of 3000 to 5500 HP replaced the original 1800 to 2200 HP installations. In addition new tonnage under design and construction using 7000 HP units turning 100 to 115 rpm, with loaded speeds of 16¼ mph or better, were beginning to enter service. In all the above cases, excessive fantail vibration occurred and required immediate consideration to permit continued operation. A research program under the direction of the senior author was sponsored by ship-building companies and vessel operators on the Lakes.

Since the stern vibration was excited by the propeller it appeared obvious to examine the fluid flow and input feed in way of and ahead of the wheel. Observations and measurements of frequency and amplitude of vibration at the stern were taken on two vessels in loaded and light condition, (1). Amplitudes of vertical vibration in the magnitude of 0.030 inch at load draft, and 0.015 inch at light draft with a common 4x revolution frequency were noted. There appeared to be a well defined depression in the water surface close to the hull and about 15 to 18 feet ahead of the wheel, a cross flow of water through the propeller aperture at the upper part, and a violent confused wake astern of the vessel. Sharp crackling noises were heard inside along the shell ahead of the wheel which seemed to denote hull or propeller cavitation.

Model tests were undertaken at the University of Michigan Naval Tank for a preliminary survey, but while confirming the sea observations, they did not aid materially, as it was difficult to visualize the sub-surface flow. It was then decided to utilize the new circulating water tank at the David Taylor Model Basin, operated by the Navy Department at Carderock, Maryland (6). These facilities permitted the model to remain stationary with respect to the observer, while the water flowed past, in contrast to the usual technique of towed models. The model was self propelled to maintain its position relative to a given speed of the circulating water, using a suitable scale propeller and rpm. The tank is provided with well lighted windows making possible visual observation from the side and bottom below the surface. The after end of the model was fitted with several short lengths of yarn variously spaced, with the leading ends secured to pins inserted in the model close to the surface, with some pins projecting a slight distance out from the model. In addition, ink was injected through a small tube at various spots of particular interest. Photographs and moving pictures were taken for future study.

The results from these tests were quite illuminating and seemed to indicate several conditions contributing to the propeller-instigated vibrations.

1. Ahead of the wheel at about the position of the surface depressins noted at sea, there was a decided change in flow from a longitudinal direction to a vertical path. This downdraft persisted to about the shaft line. Below this point the flow was perfectly normal. Aft of the downflow the water was confused and kept in close proximity to the hull instead of flowing aft. The upper half of the rudder was enveloped in a boiling semi-stationary mass of water.

The propeller is an axial-flow mechanism for the conversion of torque to thrust and the fixed blades are designed to produce lift through an efficient angle of attack provided by the pitch at any given radial element. Since the blade elements cannot adjust their pitch during a revolution, then the thrust and hence the blade load will vary with any change in the angle of attack. The angle of attack also is a function of the direction and velocity of the input feed water, and when these radically change, as shown in the model flow tests, over the propeller disk, it was concluded that the blades were being subject to heavy alternating loads, particularly at the top of the rotation. The downdraft ahead of the wheel was caused by the fact that it was much easier to draw down from the surface the required volume of feed water than to induce the flow longitudinally around the ship's form. Since the lines are materially finer below the shaft line, normal flow can be maintained in this region.

2. Another factor which disturbs the ideal axial flow to the wheel is the change in velocity and direction of the streamlines at the after end of the ship known as wake. This characteristic of a body being moved through a fluid is familiar to naval architects and results in a considerable reduction in average feed flow velocity below that of the ship's speed. The wake is composed of form wake; a part of the viscous boundary layer which is initiated at the bow and increases in thickness as the fluid flows aft; and the orbital movement of the fluid particles found in the various wave patterns induced by the hull form. The designer can only fix the pitch of the propeller to operate in an average wake, although the pitch is varied radially to partially accommodate this changing feed velocity.

3. Since about one half of the acceleration imparted by the wheel into the slip stream is induced ahead of the propeller there result areas of reduced pressure on the hull surface ahead of the wheel. This affects the normal streamline flow around the stern lines and may cause actual breakaway of the fluid

(Continued on page 14)

Fourth Annual Model Exhibition

Great Lakes Model Shipbuilders' Guild

22 - 23 August 1955 | Museum of Great Lakes History

COMPETITION

Senior Sail

First Prize	Schooner LUCIA SIMPSON	Dr. O. H. Siegmund
Second Prize	FLYING FISH	Arthur Henning
Honorable Mention	Yacht AMERICA	Emerich Kemeny

Other entrants: Hudson River sloop (Dr. O. H. Siegmund); Detroit River Sand Scow (A.L.Koeppner); JAMES F. JOY, barkentine (Capt. J. E. Johnston); Bomb Ketch (Arthur Henning); Clipper Ship (Emerich Kemeny).

Junior Sail

First Prize	Schooner NANCY	Emmett Priestly
Second Prize	Sloop of war	Wilbur J. Osborne
Honorable Mention	Schooner CHALLENGE	Emmett Priestly

Senior Steam

First Prize	Harbor Tug	Emerich Kemeny
Second Prize	Steamer NORONIC	Paul T. Hurt, Jr.
Honorable Mention	Steamer WALK-IN-THE-WATER	Ronald Konzak

Other entrants: Whaleback (A.H. Koeppner); Steamer MICHIGAN (Robert H. Davison); ASSINIBOIA (Paul T. Hurt, Jr.); INDIA (Paul T. Hurt, Jr.); MANITOU (Paul T. Hurt, Jr.); ANNA C. WILSON (Paul T. Hurt, Jr.).

Junior Steam

First Prize	Whaleback JOHN ERICSSON	Dennis & Curtis Kovach
Second Prize	Steamer WALK-IN-THE-WATER	Emmett Priestly

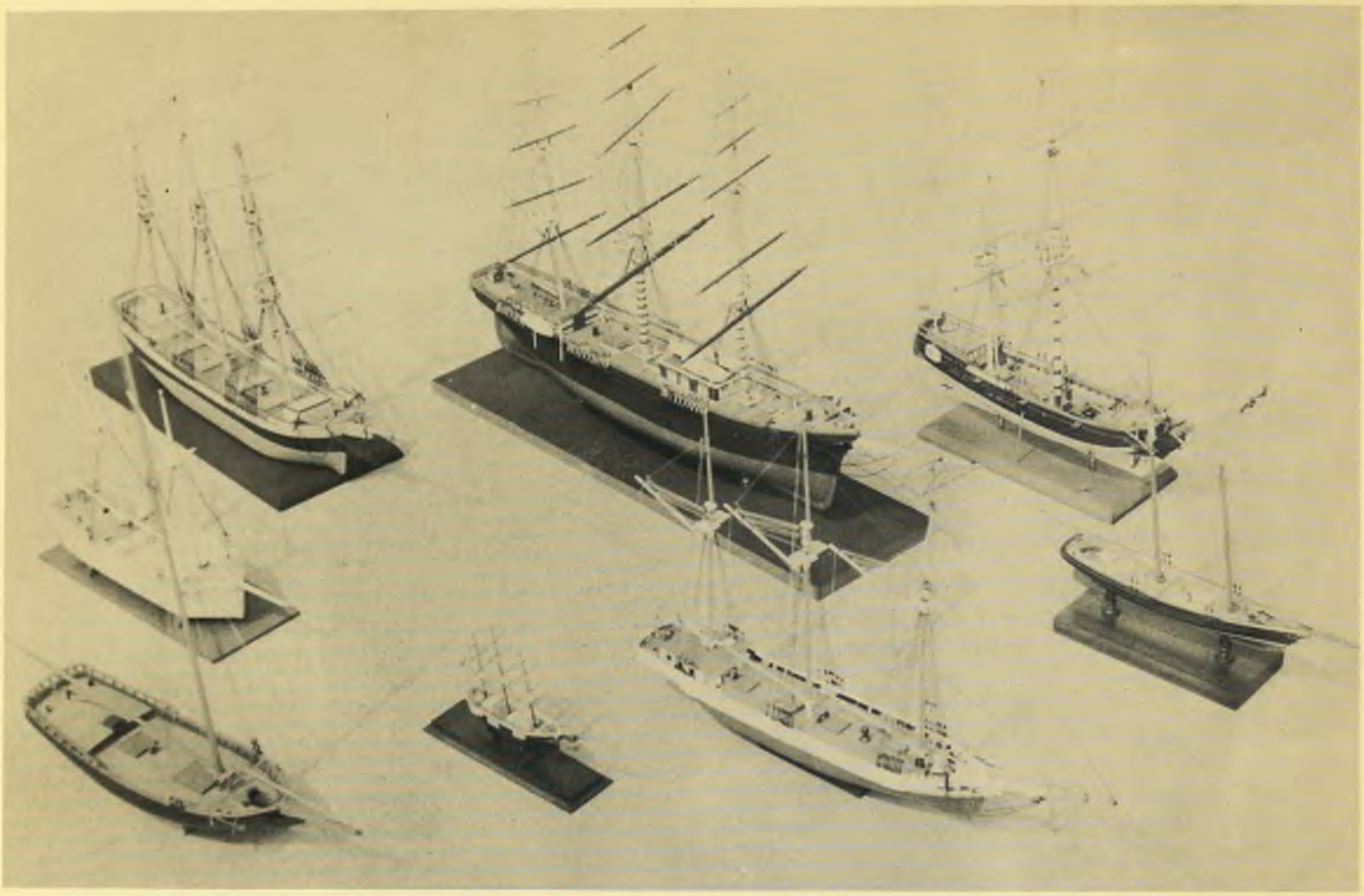
Self-Propelled

First Prize	Hog Islander JO ME LIS	Charles S. Mooney
Second Prize	Steamer WALK-IN-THE-WATER	Frank Slyker
Honorable Mention	SEA HORSE	Capt. William J. Taylor

Other models on display: Self-unloader JOHN G. MUNSON, (Kenneth L. Fairbanks); GREATER DETROIT section model (Gordon P. Bugbee).

SEPTEMBER MEETING:

On Friday, September 30, we return to our winter schedule. The meeting for this month will be held then at 7:30 p.m. at the Detroit Historical Museum. Members and their families and friends will be entertained with films and/or color slides.



Senior Sail

Barkentine JAMES F. JOY — FLYING FISH — Bomb Ketch
Detroit River Sand Scow — Yacht AMERICA
Hudson River Sloop — Clipper Ship — Schooner LUCIA SIMPSON

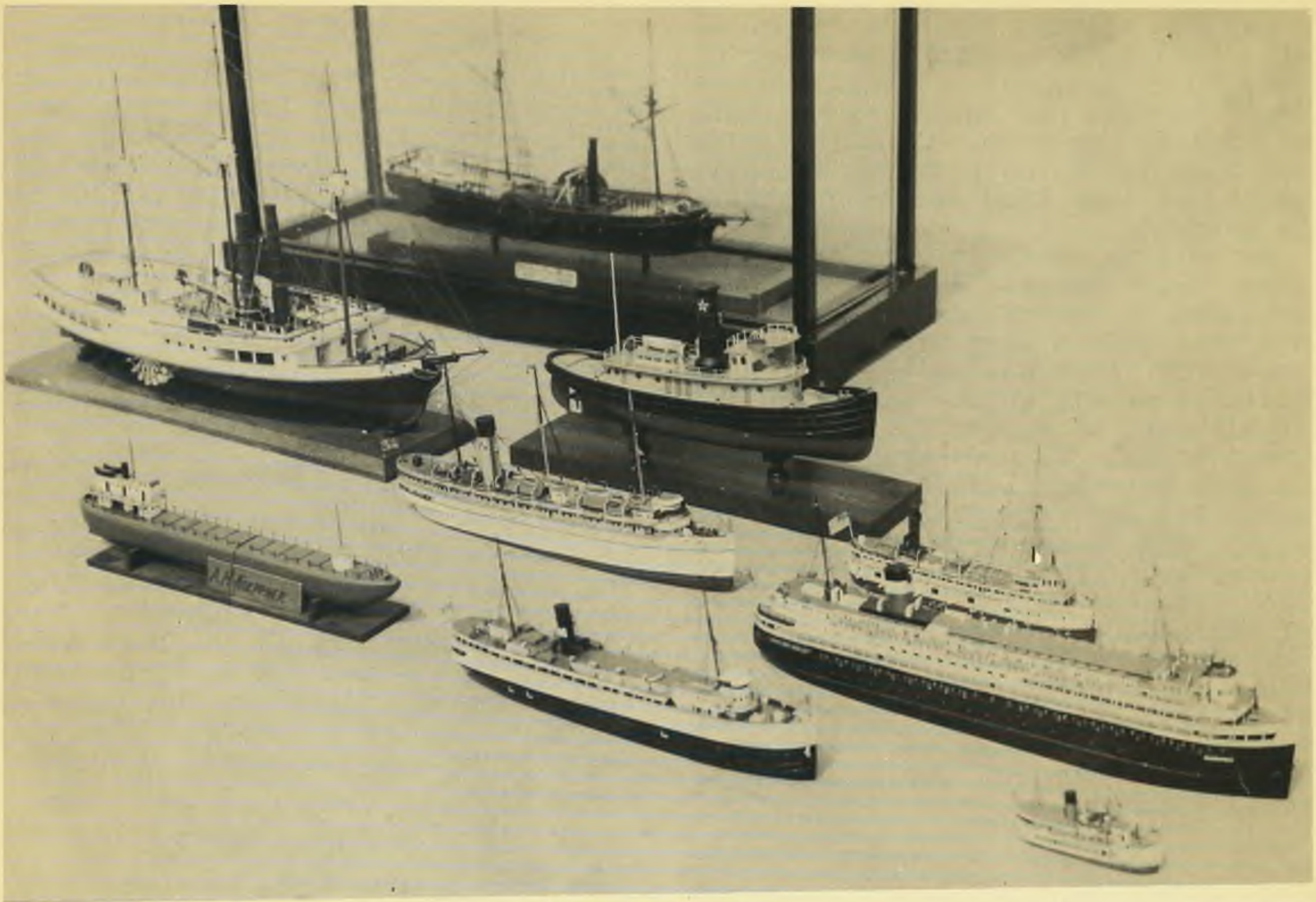
THE FOURTH ANNUAL EXHIBITION

The Fourth Annual Exhibition of the Great Lakes Model Shipbuilders'Guild was a great success. Twenty-five models were entered in the competitive section, with results as shown under the heading "COMPETITION".

The gates were opened at 11-00 A.M. on August 22, and before closing, at 8-30 P.M. 624 visitors had viewed the display. On the following day there were 750 visitors, making a total of 1374. A guest register was provided, and though only a small percentage of the visitors registered, fourteen states were represented. Gross receipts amounted to $343.50. Expenses were $8.88,for refreshments which were served to thirty-one members and their guests at the close of business on the second day. The award ribbons, which were late for the show are still to be paid for.

While the labor of putting on such a show is great the rewards are commensurated. The members and visitors who came in from considerable distances made the two days thrilling indeed. There are no idle moments opening to closing, and always there are a few special guests who linger after official closing time.

Mr.Henry D. Brown, Director of the Detroit Historical Museum served as judge. While Mr. Brown is not a model builder he has in recent times covered every maritime collection in the United States, and was able to evaluate the craftsmanship as perhaps no other available would have been able to do.



Senior Steam

Steamer WALK-IN-THE-WATER

Steamer MICHIGAN
Harbor Tug

Whaleback
Steamer ASSINIBOIA
Steamer INDIA

Steamer NORONIC

Steamer MANITOU
Steamer ANNA C. WILSON

A NEW DIVISION.

This year we were able to set up a section for powered models, and even give a demonstration of them near the museum. This is something we have had in mind for some time, and if next year brings forth enough of this type of model we will put on a real spectacle on the large basin a few hundred feet east of the schooner J.T. Wing, where the model yacht races have been held in the past.

The "JO ME LIS",(See front cover), is a self-propelled, radio-controled ocean freighter. Her cruising among the weed patches in the water adjacent to the museum quickly attracted a crowd of spectators which remained spellbound until the demonstration came to a close.

Mr.Charles S.Mooney,22 N.Third St., Columbus, Ohio, sparked the demonstration when he volunteered to put his "JO ME LIS" to the test. Frank Slyker joined him with his steam-powered "WALK-IN-THE-WATER" which as usual, performed beautifully.

The backwash from steamers passing in the river created some exciting moments and brought out the importance of a controled test basin for such operations.

Captain William Taylor's all-metal tug, "SEA HORSE", with her powerful gasoline motor, had to remain on the shelf because her batteries had been allowed to run down. Captain Taylor has been in the hospital at Windmill Point for some time so was unable to be present.

We believe that it is only one step from powered models to actual replicas of various marine engines, and that before long we will have an intensely interesting collection of historic models which will show the development of marine engines on the Great Lakes. We now have the plans of John Ericsson's engine which was installed in the "VANDALIA", first commercial vessel driven by a screw propeller. Frank Slyker just came back from the East with the drawings of the engines of the U. S. gunboat "MICHIGAN", a long-sought-for prize. Frank is constructing a working model of this historic vessel, plating the hull in a manner as nearly like the original as is possible in so small a scale.

THE JOHN G. MUNSON

Kenneth Fairbanks brought in his unfinished model of the "JOHN G. MUNSON", just as an exhibit. Already he has put two years into this model and has about one more year to go. It is a cut-away job, showing all the conveyor machinery below decks which makes it another step forward in our work of presenting history in three dimensions. Her long basket-work boom is a marvel of careful craftsmanship.

ABOVE: Model of JOHN G. MUNSON reveals self-unloading apparatus. RIGHT: Whaleback steamer JOHN ERICSSON passes while replica reposes on rail.

ANOTHER DIVISION SUGGESTED.

In the past we have been somewhat at a loss to know what to do about kit model entries. Much craftsmanship is shown in many of these, and that is to be considered, but it is hardly fair to place them in the same class with models built from scratch by the more advanced workers, some of whom even perfect their own drawings from data collected here and there. Next year there will be a special division for entries built from kits and this will settle the question.

THE LUCIA SIMPSON.

This model, which has been in several shows, received First Prize in the Senior Sail Division. We feel that this is an over-due honor, for without a doubt she is the best model of a true Great Lakes three-mast schooner ever entered in the competitive section of our shows. She was built by Dr.O.H. Siegmund, of Annandale, N.J.

AT LAST A WHALEBACKER.

At long last we have been able to show an excellent model of Great Lakes whaleback bulk carrier. Dennis and Curtis Kovach brought in their "JOHN ERICSSON" just two days before the opening. We are particularly proud of this job. The plans were perfected in the museum drafting room under the hand of James B.Jones whos carefull work on the board has brought him many compliments from naval architects and engineers from all parts of the country.

Junior Sail

Schooner NANCY

Sloop of War

Schooner CHALLENGE

Below: Frank Slyker's model WALK-IN-THE-WATER on trial run.

THE SCHOONER AMERICA

Done by Mr. Emerich Kemeny, of Detroit, this model is an example of what can be done in the way of neat work. She is a gem, and won Second Prize in Senior Sail.

Mr. Kemeny's harbor tug took First Prize in Senior Steam.

THE PAUL HURT FLEET.

Mr.Hurt entered "ASSINIBOIS", with "INDIA", "MANITOU", "ANNA C.WILSON", and "NORONIC", the last taking the Second Prize in Senior Steam. These five models posed a very definite problem for the judge in that they were of uniform quality, making it practically impossible to select any one as the best.

Mr.Hurt's work is of the best, and constitutes one of the finest contributions to Great Lakes History.

ANOTHER INTERESTING ITEM.

Gordon Bugbee,author of "Lake Erie Night Steamers of Frank E. Kirby", just concluded in our August number, brought in a cross section model of the "GREATER DETROIT". This item is really a three-dimensional illustration of his article, and shows very clearly the construction of the superstructure of one of Kirby's deluxe passenger steamers, including the elaborate ornamentation.

Perhaps the most gratifying part of the whole exhibition is the very marked improvement in craftsmanship of those who have exhibited each year since the beginning of this event. Now that we have fourteen sets of plans of Lakes vessels ready for model builders we should make great strides towards our goal of presenting these ships in model form for a record for the future.

The increased activity in the powered-model field indicates that we may look forward with some degree of certainty to the day when Detroit will count our annual exhibition as among the major attractions offered to home folks and visitors from outside.

BAEDEKER ON THE GREAT LAKES

(1907-09)

The Baedeker guidebooks to the various countries of the world are considered basic to the serious traveller, since time depreciates the value of the account little. On the other hand, for a nation so transformed in several decades, the accuracy of Baedeker's United States offers a valid source of first-hand historical data.

To Chicago by Steamer[1]

It is possible to go the whole way from Buffalo to Chicago by water through Lakes Erie, Huron and Michigan without change of steamer --the "North Land" and "North West", the two magnificent steamers of the NORTHERN STEAMSHIP CO. (each 386 ft. long, of 5000 tons burden, and accomodating 500 passengers) leave Buffalo (wharf at foot of Main St.) every Wed. and Sat. in summer at 8 p.m. (Central time). The "North Land" goes to Chicago, which it reaches on Sat. at 2 p.m.; the "North West" goes to (3 days) Duluth, and Chicago passengers must change at (1½ day) Mackinac Island. Through fare to Chicago $13.50, berths extra (from $4½, to Mackinac from $3 up.) Luggage up to 150 pounds is free. Fares to Cleveland $2.50; to Detroit $4.75; to Mackinac Island $9; to Sault-Ste-Marie, $11½; to Duluth $18 (berth from $4½). Meals à la carte. Passengers may also book on the American plan (inside rooms only); inclusive fare to Chicago from $25, to Duluth from $30, other places in proportion. These steamers are admirably appointed in every way and afford most comfortable quarters. The Northern S.S. Co. works in connection with the Great Northern Railway and offers a large choice of circular and other tours by land and water. Chicago passengers on the "North West" remain over night at Mackinac Island and on the following day take the steamer "Manitou" (3000 tons) of the NORTHERN MICHIGAN TRANSFER CO. which reaches the "Windy City" in one day more (from Buffalo 2½ days; meals on "Manitou" a la carte; berth from $1). As the "Manitou" does not call at Milwaukee, passengers for that city are sent on from Chicago by the GOODRICH LINE without extra charge.

The steamers of the ANCHOR LINE ("Tionesta" and "Juniata" the best) leave Buffalo (dock at foot of Evans Street) once or twice weekly between May 1st and October 1st for Duluth, which they reach in about 4-1/3 days (through fare, including berth and meals, $35). They leave at 11 p.m. (open to passengers after 5 p.m.) and call at Erie, Cleveland, Detroit, Mackinac Island, Sault-Ste-Marie, Marquette, and Portage Lake (Houghton and Hancock). At Mackinac Island they connect with steamers for Milwaukee and (1 day) Chicago (through fare from Buffalo $25 incl. meals and berth on Anchor Line steamers only).

Even if he has not time for the whole voyage, the traveller who is wearied of railway-travelling may be glad to make part at least of the distance by water. Stop-over checks are given by the Purser to first-class passengers on application. Warm wraps should be taken even in midsummer.

In 1907 the total burden of the vessels entering and clearing the ports of the Great Lakes in the domestic trade amounted to nearly 100,000,000 tons. New vessels are built annually with a burden of about 150,000 tons.1

Steamers at Chicago[2]

Steamers ply from Chicago to all points on the Great Lakes. Among the chief lines are the Goodrich, the Lake Michigan & Lake

1. Karl Baedeker, The United States. Leipzig, Karl Baedeker, 1909. Fourth Revised Edition. Pages 364-65.

2. Ibid, p. 368.

Superior Transportation Co., the Northern Michigan Transfer, the Northern, the Anchor, and the Graham & Morton Transportation Co. Steamers to Milwaukee run 2-3 times daily. Small steamers ply frequently (esp. on Sun. and holidays) to Jackson and Lincoln Parks and larger ones to St. Joseph, South Haven, and other points. The steamboat wharves are mainly along the river, within ½ M of its mouth.

Steamers and Ferries at Detroit[3]

Ferries ply from the foot of Woodward Ave. to Belle Isle (calling at the foot of Joseph Campau Ave.), and to Windsor every ¼ hr., and to Amherstburg and Bois Blanc Park at 9 a.m. and 3:30 p.m., and from the foot of Joseph Campau Ave. to Walkerville every ½ hr. Steamboats ply to the Put-in-Bay Islands, St. Clair, Cleveland, Buffalo, Port Huron, Sault-Ste-Marie, Mackinaw, and other points on the Great Lakes.

From Owen Sound to Fort William[4]

STEAMER...to (555 M) Fort William in 45 hrs. (fare $17.50, incl. meals and stateroom; through fare from Toronto to Fort William $21.15; from Montreal $28.45.

This forms part of the so-called "Lake Route" of the Canadian Pacific Railway; and tickets from Eastern points to Fort William or points farther to the W. are available either by this route or by railway. Travellers who are not pressed for time are strongly advised to prefer the "lake route" as they miss comparatively little of interest on the railway between Montreal and Fort William and gain an opportunity to see something of the scenery of the Great Lakes, the Sault-Ste-Marie Canal, etc.

3. Ibid, p. 359.

4. Karl Baedeker, The Dominion of Canada. Leipzig, Karl Baedeker, 1907. Third Revised Edition. P. 222.

The C.P.R. Steamers, leaving Owen Sound on Tues., Thurs. & Sat., are among the finest vessels for inland navigation in the world, affording excellent accomodation, service and cuisine. The season of navigation lasts from about May 1st to Oct. 1st; and in summer the water of the lakes is generally smooth. In compliance with the laws of Ontario, no wines or spirits are sold on the steamers.

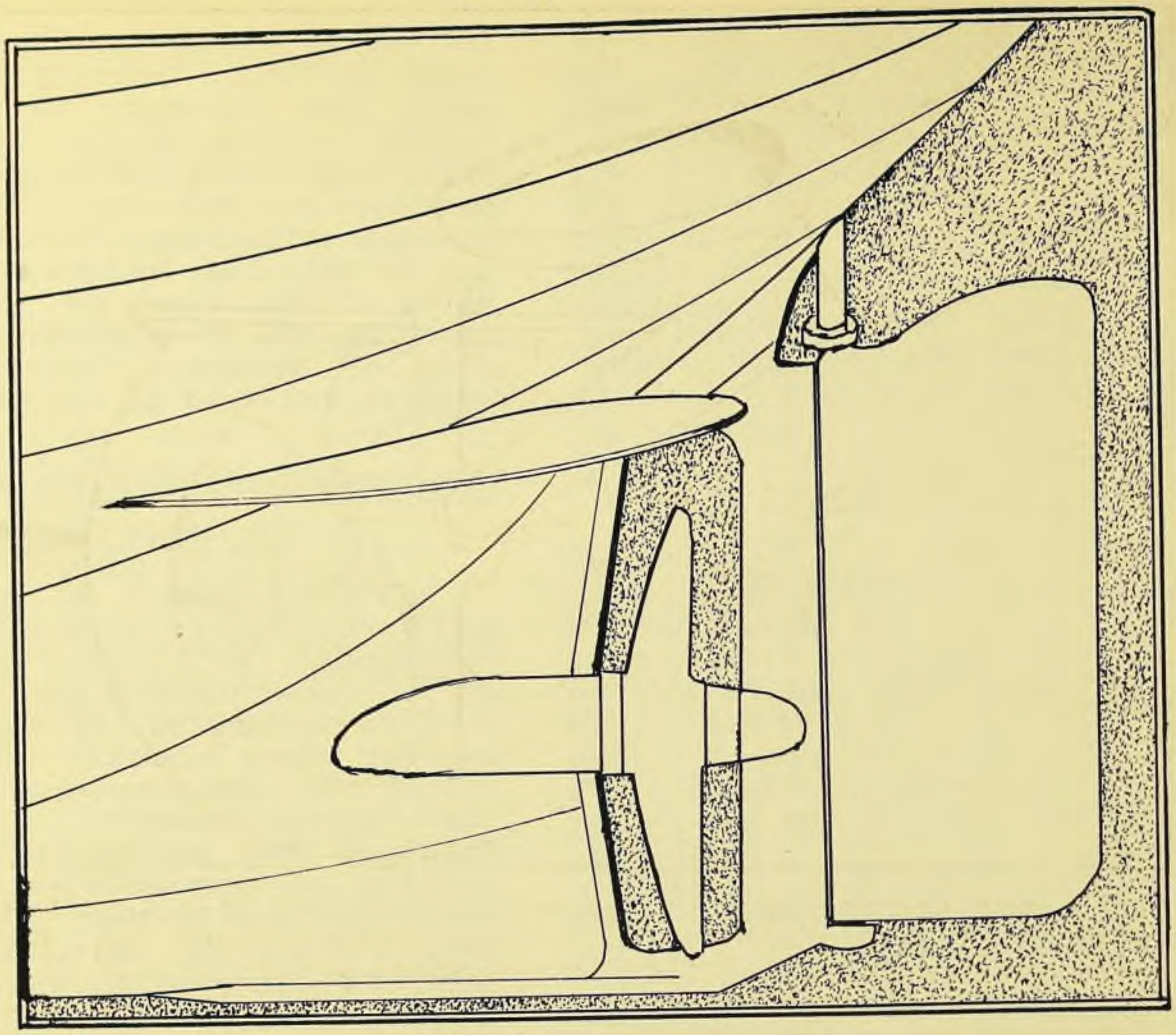
From Owen Sound to Sault-Ste-Marie By the North Channel[5]

485 M. Steamers of the Northern Navigation Co., starting from Collingwood on Tues., Thurs. & Sat., leave Owen Sound about 11 p.m. on the arrival of the evening express from Toronto, and run to the N. through Georgian Bay and the "North Channel" (between the mainland and Manitoulin Island) calling at many points on the N. shore of Lake Huron. The voyage takes about 2½ days, and ample time is generally allowed for landing at the various ports. The steamers and their accomodation are good, and the trip is healthful and enjoyable in summer (fare $10, return fare $18). The Tues. boat runs due N. through Georgian Bay, while the others run via Parry Sound and the N. Shore ports. The other points called at are Killarney...; Manitowaning...; Little Current...; Spanish River ...; Serpent River; Algoma Mills; Blind River; Thessalon; Bruce; and Hiawatha Camp. The steamer calls at the Canadian town of Sault-Ste-Marie before crossing to its terminus on the American side. In July and Aug. the steamers go on from the Soo to Mackinac (fare $14; round trip in 6 days, $25.

Steamers of the same company ply from Collingwood, Penetang, and Midland, through the "inside Channel" to Parry Sound, French River, Byng Inlet, Killarney, etc.

5. Ibid, p. 223

6. Ibid, p. 226.



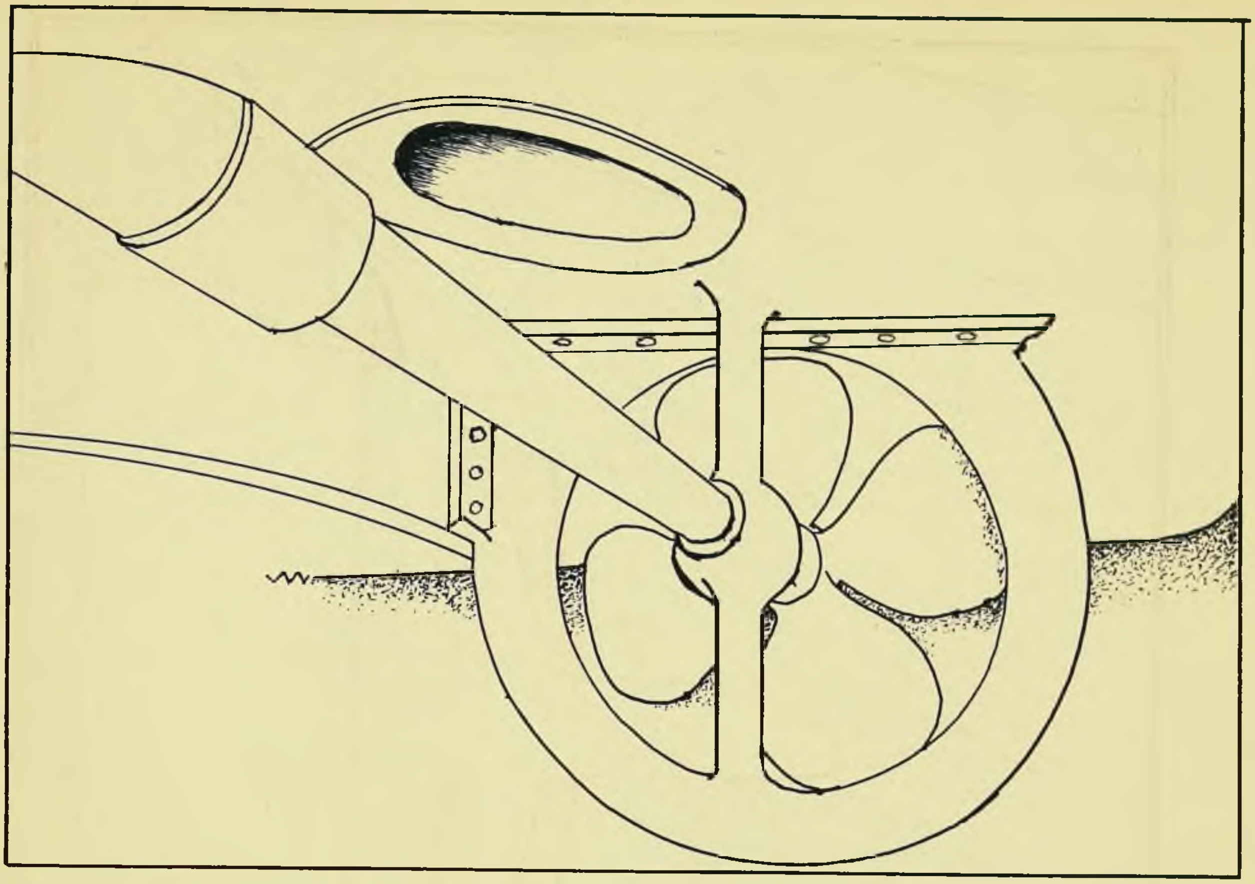
SHIP VIBRATION
Continued from page 6

from the hull surface causing cavitation and vapor bubble collapse. Since these phenomena are intermittent in formation, some authorities believe part of the vibration may be caused by this hull cavitation and alternating pressures, and hence not be transmitted to the ship through the shaft bearings, (3).

4. The propeller itself may cavitate with consequent impacts due to bubble collapse. this is a rather common cause of vibration where insufficient blade area or inferior section design is used, and is experienced in high speed, high powered vessels, and in towboats on the inland waterways where the propeller diameter is limited by the available depth of water.

5. In twin or multiple screw vessels, vibration may be caused by local variations in feed water velocity induced by struts or bossings ahead of the propellers, or from the partial entrance of the blades into the boundary layer.

The obvious solution to the above unfavorable factors, with the exception of item 4, is to fine up the hull lines aft, since the location of the propeller is fixed in a fore and aft direction. In fact, this is the only attack on the problem of stern vibration which has been made in the past. As power is increased for higher speeds further fineness is introduced which ultimately means larger vessels to carry the required cargo. The earning capacity depends on the deadweight carried, and every ton of displacement sacrificed to reduce vibration is an economic loss. In the case of high powered naval vessels and passenger liners, where the limit in form fineness was approached, excessive stern vibration still is frequently experienced.



The above sketch shows the essential features of a device used with considerable success on a river towboat where the wheels were starved for axial flow in the shoal waters of the Illinois River. Two 24-inch diameter tubes were built into the hull, taking in water from forward and discharging into the upper half of the propeller disk, port and starboard. Power and revolutions were maintained in shoal water and maneuvering improved.

PRACTICAL SOLUTION

After a study of all the available data it was concluded that if the apparent starvation of the wheel in the feed water supply were improved, the major factor instigating vibration might be reduced sufficiently to a degree where the residual shaking would be tolerable and of menor influence on structural fatigue.

Five different solutions have been tried:

1. Prior to the completion of the research it was necessary to proceed with the design of a new vessel of 7000 HP. Since no other method was yet at hand the run was lengthened and fined up with a corresponding reduction in displacement of some 500 long tons. This vessel is now in service and the stern vibration reasonably tolerable, although the fins described in the next paragraph will be installed this winter. However, it is not yet certain whether the loss in revenue due to decreased capacity will be made up by the increase in speed resulting from the lower block coefficient.

2. Horizontal fins, port and starboard, as shown in the photograph, Figure 2 and drawings, Figures 3 and 4, were fitted to the model being tested in the circulating water tank. It was apparent immediatly that the fins eliminated the downdraft and completely cleared up the entire flow of water to the propeller and rudder. These fins have now been fitted on some 22 ships with uniform success in the suppression of stern vibration. In addition there has been a definite

gain in speed in almost all cases. The amplitude as measured at sea was reduced to 0.006 inch, or one fifth of the value prior to the installation of the fins. While the benefit to the hull structure was obvious, the psychological improvement was even greater. To the stewards, cooks and engineering personnel who were quartered aft, the vibration had completely disappeared. It was a spectacular difference to those who had lived with annoying vibrations and physical discomfort for so many years.

3. Vertical streamline fins again were fitted outboard of the propellers on a twin screw towboat operating on the Ohio River, which had experienced vicious stern vibration. In this case the wheels were drawing water from the sides rather than down from the surface, since the shoal water and tunnels restricted the flow from forward. After the fins were installed a coin could be balanced on edge where previously steel brackets and welding had failed from the vibration.

4. In another case of a river towboat, where the wheels were starved for axial flow in the shoal Illinois River, a different device was used with considerable success. As shown in the photograph, Figure 5, two 24-inch diameter pipes were built into the hull, taking water from forward and discharging into the upper part of the propeller disk, port and starboard. Power and revolutions were maintained in shoal water and the maneuvering of the towboat pushing a flotilla was materially improved.

5. Another solution is being tried on a new vessel now under construction on the Great Lakes, where the lines aft were not fined but were flared out to a somewhat "T" section incorporating in a way the fins into the hull proper. Model tests indicated this overhang at the top may likewise discourage the downdraft.

As a result of the above methods, stern vibration has for all practical purposes been eliminated by a modest investment in cost and fluid research.

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