Changes in Traditional Technology in Boxes for Transport*

By

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1. Introduction

The containing, storage and transport of goods consist of an important part of our daily life. We have used boxes for these purposes. As the transport of supplies and other goods increased, boxes mainly for transport purposes were devised. In Japan, in the Edo Period, a number of uniquely designed-chests and boxes for carrying goods appeared one after another as the sankin-kotai (the system of alternate residence of feudal lords in Edo, the present Tokyo, who were compelled by the Tokugawa shogunate to reside both in Edo and in their domains alternately for usually a year or two, making their wives and children live in Edo as hostages) was introduced and wedding processions, traveling and commercial activities came more popular. Among them were nagamochi (long chest), hasami-bako (small box carried by a pole), tsuzura (bamboo case(1)), kouri (wicker case) and middle-size chest which will be described later in more detail. Then in the mid-nineteenth century and after, as foreign technology was introduced, new types of boxes began to be used by the armed forces and by the general public. I called

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(1) In this paper, "box" is a general term for small wooden receptacle, "case" is a term for receptacle whose cover is totally overlapping the body.
these boxes "boxes for transport"(2) in my paper presented to the 7th conference of this Society.

How have the concepts and techniques of Japan's traditional boxes been changing since the Meiji-era (1868–1912)? When we examine the patents and utility models of boxes from this viewpoint, we find that new containers and traditional boxes for transport differ in many respects. This paper deals with the concepts of these boxes for transport and method of using materials to make these boxes.

### 2. Traditional boxes or transport in Japan

(1) Concepts and types of boxes

First of all, we will identify the concept of hako (Japanese for box) that has historically been formed in Japan. "Wakan Sansai Zue" published in 1713 says that both hitsu (chest) and zushi are receptacles and that hitsu is a receptacle with a mouth and lid on its top, hako is a small hitsu and zushi is a receptacle with a mouth and door on its front. Similar descriptions can also be found in the definition of chest and box of "Encyclopedia Britannica" and Oxford English Dictionary". But it was more recent that the word cabinet came to mean the furniture with a mouth and door on its front, and it doesn't seem that there is no English word exactly corresponding to zushi(3). Though it is defined that a chest is larger than a box, we cannot determine the exact border between the two words. Here, we will call a receptacle that can be carried by a person "box", and one that cannot be moved by a person "chest".

A box with its mouth on its top has the function that can be called "personal function", its walls cuts off the contents from people's eyes and the box helps prevent theft. It also has "objective function" : it prevents the contents from crushed or otherwise damaged by outer force and helps avoid scattering your belongings about, thus protecting the contents. Finally, this type of box has "environmental function" it can protect the contents from rain, moisture, dust, rats, insect pests, etc. People make boxes to obtain these functions, and devise a variety of new boxes to reinforce one or more of these functions. There are two broad categories of boxes: one of them is

(2) Satoshi MIYAUICHI : "Development of folding box in Japan"

(3) The English word "cabinet" is an architecture term meaning a small room where paintings and rare articles are decorated and it was in the second half of the 17th century that this word came to mean a box-type furniture equipped with shelves, drawers and doors as used today. (John Gloag : A Short Dictionary of Furniture, George Allen and Unwin Ltd., 1969, p.16)
the boxes exclusively used stationarily as elements of interior spaces, while parades. Container-type boxes, which are the theme of this paper, are those used for transport of goods repeatedly (4).

(2) Traditional boxes for transport in Japan

Examples of the traditional boxes that meet the definition of container-type boxes are shown in Figs.1 and 2. Fig.1 is hitsu used in Kagoshima Prefecture which is now displayed at the Kawanabe-cho Culture Center, Kagoshima Prefecture. Fig.2 is nagamochi stored by the National Museum of Ethnology. The former has a size of 780L x 438W x 538H (mm) and is made of a single board of sugi (Cryptomeria Japonica D.Don) about 19 mm thick. Both its inside and outside surfaces are finished with an adze (5). The eight-layer joint (6) was used to construct the box, and the technique is highly accurate. Both the inside and outside are brown in general, and they were probably painted with persimmon tannin or similar material and turned brown as the time passed. At the mouth, the hitsu has brackets supporting the frame that fits the cover frame, and no chamfering was made.

Fig.1 chest Kawanabe-cho Culture Center
Kagoshima Prefecture

Fig.2. chest National Museum
of Ethnology

The hitsu have no handle. The crosspiece attached around the hitsu up to its mouth has two L-shaped holes, and the corner of the bottom panel just below the crosspiece wears away. This suggests that this hitsu was used for carrying things.

(4) Those boxes which are made as a piece of furniture to compose a living space are seldom moved. Another chests and boxes which rarely attract attention are classified as storage-type ones.

(5) This hitsu has unique uneven patterns on its surface and the surface is not plane smooth. But the joints are accurately finished, and the crosspiece of the cover is also made smooth.

(6) This is the method of joining boards by making mortises and tenons on the boards so that the boards may fit into each other tightly and fixing them with nails.
Table 1 shows some *hitsu* which look like this box well in size, proportion and lock plate design. All of these chests have the above-mentioned characteristics. Their size is about half that of *nagamochi*, but the board used is about 20 mm thick, which is similar to or greater than in thickness that used for *nagamochi*. With all attention put into practical use, the chests are designed simply.

Because their lids are thick and even, you can pile them one upon another. The cover is made of a single board, giving almost no possibility of allowing rain inside. No chamfering is added to their corners, and no decoration metal fitting and handle are used. These chests have locks. Some of them use layer joint or dove-tail joint, or lack bottom battens. As noted above, the chests with bottom battens have two holes on their front and back, which correspond to the holes on the lids.

### Table 1 Traditional box for transportation in Japan

<table>
<thead>
<tr>
<th>Name of Keeping</th>
<th>Close Chest</th>
<th>Hitsu</th>
<th>Hitsu</th>
<th>Small Nagamochi</th>
<th>Hitsu</th>
<th>Nagamochi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place of Use</td>
<td>Okinawa Prefectural Museum</td>
<td>Kagoshima Prefectural Culture of Reiseikan</td>
<td>Kawanabe-cho Culture Center</td>
<td>Kagoshima Pre.</td>
<td>K. Takahashi Eno-kizu, Okawa City</td>
<td>Fukuoka Pre.</td>
</tr>
<tr>
<td>Scale (mm)</td>
<td>8351-470w-530h</td>
<td>Okinawa pref. Nejime cho, Kagoshima Pre. 7631-459w-564h</td>
<td>7801-439w-538h</td>
<td>Cryptomeria</td>
<td>7331-426w-524h</td>
<td>Cryptomeria</td>
</tr>
<tr>
<td>Material</td>
<td>unknown Cryptomeria</td>
<td>10-layer Joint</td>
<td>9-layer Joint</td>
<td>9-layer Joint</td>
<td>9-layer Joint</td>
<td>9-layer Joint</td>
</tr>
<tr>
<td>Joint Body</td>
<td>dovetail</td>
<td>4-layer Joint</td>
<td>5-layer Joint</td>
<td>3-dovetail</td>
<td>3-layer Joint</td>
<td>3-layer Joint</td>
</tr>
<tr>
<td>Bracket Cover</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Bottom Bracket</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Lock Reinforce.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Plate Metal</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Hanging Metal</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Finish</td>
<td>permismon</td>
<td>permismon</td>
<td>permismon</td>
<td>lacquer</td>
<td>natural</td>
<td>permismon</td>
</tr>
<tr>
<td>Thickness of Board (mm)</td>
<td>20</td>
<td>17</td>
<td>21</td>
<td>18</td>
<td>21</td>
<td>21</td>
</tr>
</tbody>
</table>

(7) The box stored in the Culture Center of Kawanabe-cho, Kagoshima Prefecture and the one owned by Takahashi from Okawa, Fukuoka Prefecture have no name-plates, and the author gives them names according to the definitions. It is also not clear whether the names of the *nagamochi* stored in the National Museum of Ethnology and others were given by the users or by the collectors’ judgment.
The L-shaped holes on the frame and holes on the bottom battens, which are worn away, differs clearly from those found on nagamochi, which is carried only once at the wedding ceremony. From the paintings on the six-fold screen stored at Tokaiian Temple in Kyoto, which is believed to have been drawn in the early Edo-era, and from fishing tackle boxes with similar holes, it is evident that cords were run through these holes. People probably carried two hitsu at once by hanging them on both ends of a bar, or one on their back. This differs from kara hitsu and nagamochi in that the latter were always transported by two persons ceremoniously. Hitsu resembles kouri, tsuzura and akeni(bamboo case) in size and in the use of cords. But since it is built more strongly than them and is lockable, hitsu has a far higher capacity to protect contents. From the above discussion, we may conclude that the chests shown in Table 1 are the prototypes of traditional boxes for transport in Japan. Since these chests have been found widely in the country, they may have been used on ships as well.

3. Patents and Utility Models of boxes for transport

Goods in transit are liable to many troubles in personal, objective and environmental situations. Since 1885 when the Patent Law was enacted in Japan, a variety of boxes have been invented by people both at home and abroad to minimize these troubles and have been registered as patents and utility models.

Table 2 Patent entitled "folding"

<table>
<thead>
<tr>
<th>Date of Notice</th>
<th>Pat.No.</th>
<th>Title</th>
<th>Applicant</th>
<th>Principal Materials</th>
<th>Methods and Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1903. 5. 8</td>
<td>8228</td>
<td>folding box</td>
<td>F.Fukamachi/paper/folding,strengthen and reduce volume by paper ply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1905. 2·16</td>
<td>8427</td>
<td>folding box</td>
<td>T.Kobayashi/wood/reduce volume,easy handling and carrying</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1911· 2·20</td>
<td>19389</td>
<td>Muraki style folding box</td>
<td>Tokyo,A. Muraki/paper/reliable paper ring construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1911·10·18</td>
<td>20806</td>
<td>folding luggage box</td>
<td>America,C.Fastner/wood,wire/strengthen of frame by wire bracing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1912·1·11</td>
<td>21434</td>
<td>folding luggage box</td>
<td>Nagano,S.Nohizuka/wood/knockdown by spring hinge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1919·8·13</td>
<td>34940</td>
<td>improvement of folding boxes</td>
<td>U.K.,Richard, Henry, Robert/wood/iron rod and plate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1919·12· 2</td>
<td>35445</td>
<td>collapsible box</td>
<td>U.K.,J.,Lowe/wood/panel construction for easy carrying</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1922·3· 1</td>
<td>41915</td>
<td>Furuza style folding box</td>
<td>for carring · Kyoto,T.Furuza/wood/complex construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1922·4·11</td>
<td>45208</td>
<td>folding box</td>
<td>Tokyo,G.Nagai/wood/folding by special hinge,reduce volume</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1943·10·30</td>
<td>159852</td>
<td>collapsible luggage box</td>
<td>Tokyo,G.Motuzen/wood/folding by iron lods,materiel saving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1945·12·27</td>
<td>171984</td>
<td>folding box</td>
<td>Tokyo,K.Yoshiwara/wood/folding system w/o metal hinge and fastenings</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(8) The shape of tenons is compared to that of the body of an ant which is narrow in the middle. In English, the shape is compared to the tail of a dove or fox and is called dove-tail or fox-tail joint. This joint is hard to come off, strong and beautiful in appearance. So it is widely known as an elaborate joint technique.
I examined those patents and utility models registered from the early years of the Law to the 1940s, and found about 40 patents and 80 utility models which might have more or less connection with boxes for transport. The terms oritatami (folding), kumimate (knockdown) and kumiawase (combining) were often included in the titles, and there is a wide gap between this fact and the traditional concept of boxes mentioned earlier. We will thus examine some actual examples.

Table 3 utility model entitled "folding"

<table>
<thead>
<tr>
<th>Date of Notice</th>
<th>Utility Model No.</th>
<th>Title</th>
<th>Applicant</th>
<th>Principal Materials</th>
<th>Methods and Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1916-12-19</td>
<td>41777</td>
<td>folding box for emergency</td>
<td>Koria, M.Yamamoto</td>
<td>convenient, built in shoulder belt</td>
<td></td>
</tr>
<tr>
<td>1924-9-4</td>
<td>84079</td>
<td>folding small box for food</td>
<td>Saga, M/Minami-kawa</td>
<td>wood/strong folding construction</td>
<td></td>
</tr>
<tr>
<td>1925-9-22</td>
<td>96264</td>
<td>folding luggage box</td>
<td>Nagano, T.Murata</td>
<td>wood/simple folding system by iron hinge</td>
<td></td>
</tr>
<tr>
<td>1926-11-20</td>
<td>103851</td>
<td>folding chest for bedclothes</td>
<td>Tokyo, K/Takahashi/paper</td>
<td>folding large paper box</td>
<td></td>
</tr>
<tr>
<td>1927-6-21</td>
<td>109129</td>
<td>folding box for emergency</td>
<td>Nara, M./Inou</td>
<td>wood/automatic folding prefabricated box</td>
<td></td>
</tr>
<tr>
<td>1923-3-17</td>
<td>117869</td>
<td>folding box</td>
<td>Tokyo, Y.Kakuda</td>
<td>wood/folding construction by means of hinge</td>
<td></td>
</tr>
<tr>
<td>1928-11-15</td>
<td>127988</td>
<td>folding luggage box</td>
<td>Tokyo, Nagata</td>
<td>folding construction use of angle frame</td>
<td></td>
</tr>
<tr>
<td>1931-10-8</td>
<td>161596</td>
<td>folding box with metal fittings</td>
<td>Kyoto, G.Ran</td>
<td>paper/simple and strong paper box</td>
<td></td>
</tr>
</tbody>
</table>

As noted above, oritatami means folding, and in the case of boxes the word is defined more strictly: parts of a box are not separated from one another so that the box can be folded into a smaller size. Table 2 lists the patents having the term "oritatameru" (can be folded) in their titles, while Table 3 lists the utility models with the term in their titles.

Table 4 patent entitled "knockdown"

<table>
<thead>
<tr>
<th>Date of Notice</th>
<th>Patent No.</th>
<th>Title</th>
<th>Applicant</th>
<th>Principal Materials</th>
<th>Methods and Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1907-4-17</td>
<td>11964</td>
<td>knockdown box for transportation</td>
<td>Okayama, S.Tsuji</td>
<td>wood/reduce volume by fittings</td>
<td></td>
</tr>
<tr>
<td>1925-5-14</td>
<td>63859</td>
<td>knockdown luggage box w/o nails</td>
<td>Sendai, G.Sugimoto</td>
<td>wood/material saving by wire</td>
<td></td>
</tr>
<tr>
<td>1926-1-25</td>
<td>67257</td>
<td>improvement of luggage box</td>
<td>Sendai, G.Sugimoto</td>
<td>wood/improvement of patent no.63859</td>
<td></td>
</tr>
<tr>
<td>1926-6-30</td>
<td>68785</td>
<td>revision of knockdown luggage box w/o nails</td>
<td>Sendai, G.Sugimoto</td>
<td>wood/easy opening</td>
<td></td>
</tr>
<tr>
<td>1927-9-14</td>
<td>73457</td>
<td>knockdown wooden box</td>
<td>Kobe, K.Kawada</td>
<td>wood/easy knockdown panel system</td>
<td></td>
</tr>
<tr>
<td>1936-3-13</td>
<td>114733</td>
<td>metal fittings for knockdown</td>
<td>Sendai, Y.Yamada</td>
<td>wood/burglarproof hinge device</td>
<td></td>
</tr>
<tr>
<td>1939-10-26</td>
<td>132911</td>
<td>knockdown wooden box</td>
<td>Tokyo, S.Kohara</td>
<td>wood/strong, elastic, airtight box by thin board</td>
<td></td>
</tr>
<tr>
<td>1944-1-14</td>
<td>160976</td>
<td>knockdown small wooden box</td>
<td>Tsu, S./Ito</td>
<td>wood/cheap and strong box w/o metal and glue</td>
<td></td>
</tr>
<tr>
<td>1944-4-11</td>
<td>163573</td>
<td>knockdown box</td>
<td>Numazu, S.Watanabe</td>
<td>wood/device of strong box by wires, w/o metal</td>
<td></td>
</tr>
<tr>
<td>1945-2-19</td>
<td>169867</td>
<td>knockdown luggage box</td>
<td>Hyogo, S.Kataoka</td>
<td>wood/easy knockdown system w/o nail, rivet</td>
<td></td>
</tr>
</tbody>
</table>

There are many titles having the term kumitate or kumiawase, too. In this system, parts of a box are separated and you can put these parts together into a box. After you take out the contents, you can take the box apart to parts and store the parts or return them to the sender. Here we will call this system the knockdown system. Table 4 shows the patents having
kumitate or kumiawase in their titles, and Table 5 shows the utility models with the word in their titles. and those named simply box or receptacle include some boxes of the folding or knockdown type. We will study some characteristic ones among these boxes.

Why are oritatami, kumitate and kumiawase used so often as the titles of patents and utility models of boxes? According to a survey conducted by Nippon Express Co. in 1949, 80 to 90% of container use was for return of emptied boxes. Thus, to the boxes for transport which are used repeatedly, it is an important technical theme to reduce the volume of empty boxes by simplified structure and handling. The descriptions of the patents and utility models also suggest that another major consideration was the factor of space saving in case boxes would be loaded into a ship or vehicle.

Table 5 utility model entitled "knockdown"

<table>
<thead>
<tr>
<th>Date of Notice</th>
<th>Utility Model No</th>
<th>Title</th>
<th>Applicant</th>
<th>Principal Materials</th>
<th>Methods and Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920·4·13</td>
<td>51951</td>
<td>knockdown box</td>
<td>Tokyo,B.Kamijo/ metal sheet/reduce volume, knockdown and folding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1922·4·10</td>
<td>64238</td>
<td>Asahi style knockdown box</td>
<td>Kobe,K.Asahi/ wood/knockdown and stacking by angle, wire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1923·1·29</td>
<td>70607</td>
<td>knockdown luggage box for transportation</td>
<td>Kobe,N.Sekiguchi/ wood/quick knockdown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1923·4·12</td>
<td>80480</td>
<td>knockdown box</td>
<td>Osaka,K.Kamioka/ wood/knockdown construction for cabinet drawers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1924·11·24</td>
<td>85221</td>
<td>knockdown box for food</td>
<td>Osaka,Y.Tsumori etc./ wood/simple thin board construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1928·5·14</td>
<td>118658</td>
<td>knockdown wooden box</td>
<td>Kobe,K.Furumori/ wood/complex construction by band and panel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1928·7·24</td>
<td>123849</td>
<td>knockdown luggage box</td>
<td>Fukuoka,H.Ninakoshi/ wood/folding brace construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1948·12·10</td>
<td>179263</td>
<td>knockdown luggage box</td>
<td>Shizuoka,Y.Kato/ wood/easy folding and knockdown, multiple use</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Methods of reducing volume of boxes for transport

(1) Staking System

This section examines the methods of reducing the volume of boxes. One of these methods is stacking, that is, the method of smaller boxes are put into larger ones in succession. This method can be observed in various daily utensils, such as table-ware. It was introduced to boxes for transport, too. In 1942, in the midst of World War II, Nippon Express, in compliance with the government policy recommending the effective use of available resources, ordered from wooden box manufacturers about a total of 1,000 sets of small-sized bamboo containers of the folding type and wooden boxes of the knockdown type, both of a size 545L x 455W x 303H (mm). These containers and boxes were to be used for the transport of goods, especially for those who moved for safety from large cities to the country. The person who devised them was Kosaku Katayama. The boxes were of

the stacking system, each set consisting of four boxes named A, B, C and D. The largest was box A, 910L x 600W x 730H, built with 18 mm thick boards of sugi and matsu (Pinus densiflora), and boxes B, C and D could be fit into box A in this order. Box D, the smallest, was made of boards of 9 mm thick and of a size close to that of a wooden box for containing a petroleum can. The stacking system was a device for saving freight rates of returning emptied boxes. But a set of the four boxes weighed as much as 45 to 50 kg and was difficult to handle. Moreover, lids were often lost, and the sets were sometimes incomplete, which obstructed their subsequent use. Thus, Nippon Express had to procure supplement lids and boxes and repair damaged ones.

As the war intensified, efforts to improve were suspended and none of these boxes have been found. As described above, the stacking system was not very suited to the boxes for transport handled by unspeakable individuals, since it had the defects mentioned above.

(2) Folding system

One early example of folding-system boxes is the folding box invented by T. Kobayashi, Pat. No.8427, notified on February 16, 1905 (Fig.3). Kobayashi stated the aim of his invention clearly: "To reduce the volume of boxes so as to make them easy to handle and transport." As shown in Fig.3, each panel of the box is linked with hinges, and the side panels can be folded in the middle. The joint parts of the lid and side panels are cut at 45 degrees so that they may be put together closely. The thickness of the panels is adjusted so that they may be folded into a block, and battens are attached to the panels to reinforce them. The panels are heavy and are likely to warp as the time passes. But we can see the fundamental principle of folding boxes in this.

Now we will study another folding box invented during World War II. Fig.4 shows a folding box for transport, Pat. No.159852, notified on October 30, 1943. Devised by G.Mokuzen from Tokyo, this box consists of clubs, which are put together in parallel crosses, with holes made on each cross of clubs and bolts applied to the holes to fasten clubs. It can be folded as shown in the figure. The lid and bottom panel are inserted between the clubs to form the shape of a box and to prevent deformation. The inventor states the purpose as follows: "The clubs can be folded, virtually flat, thus reducing the volume of empty boxes. Because of this, no large space is needed for returning or storing empty boxes. He also explains that while the box can be used as it is for large-sized articles, plywoods etc. can be applied to cover the space between clubs for smaller things which may get out of the space. He emphasizes that the box can save the use of metal and wood yet is strong.
enough. Apart from the feasibility of manufacturing and using this box, it does propose a fundamental idea of folding boxes.

Fig. 5 is a knockdown box for transport, Pat. No. 21434, notified on January 11, 1912. This was devised by S. Mochizuka from Nagano Prefecture. Standardized thick panels are used to assemble boxes, which are fixed with steel bands also serving as hinges. If the steel bands are removed, the box can be disassembled. Mochizuka says that the box can be made strongly. A box for transport, Utility Model No. 99411, is shown in Fig. 6. Notified in January 1926 and devised by Y. Okada from Tokyo, this box is a folding one in which the side panels on the shorter sides fold inwardly.

Okada proposes leather and canvas as the materials of hinges, and emphasizes easy assembling and high shrinking efficiency. It should be pointed out that the method of folding the shorter sides inwardly resembles that of Nippon Express-type containers described later (Fig. 16).

The invention having the title Box invented by National Wire Band Box Company notified in 1905 (Pat. No. 8510) was a realistic idea considering the
The fact that boxes of a similar design were used in the 1950s, half a century after. The idea was to use wires instead of nails to fix the box and can be one of mass-production techniques. This patent's owner is a British man. Other patent applicants include Americans, Englishmen and New Zealanders. This suggests that international competition for patents of boxes for transport started immediately after the Patent system was introduced in Japan.

The box of Utility Model No.94499 invented by H. Suzuki from Tokyo, which was notified on August 27, 1925 (Fig.6) resembles much the duralumin container that was put into practical use by Nippon Express after the War (Fig.17). This box consists of metal plates fastened with hinges and can be folded. It is lockable, and the inventor emphasizes that it is easy to assemble, transport and store.

One noteworthy fact about folding boxes is the use of hinges. Other fastening devices included wires and cords. There was also an idea that an iron rod was used as the pivot.

Fig.6 Utility Model No.94499, 1925

(3) Knockdown system

Now we will look at some examples of knockdown-type boxes in which parts are put together or combined into boxes. The knockdown box for transport notified on April 17, 1937, Pat. No.11964, is an early example (Fig.7). Sukesaburo Tsuji from Okayama, who devised this box, said in the beginning of the patent application as follows: "This invention relates to a box put together by fastening six panels with metal fittings, which can be sealed. The purpose is a knockdown box for transport articles. The box can be disassembled so that the volume can be reduced, making transport easier. Another purpose is to prevent the label from being removed."

As shown in Fig.7, this box can be taken apart by removing the pins and rods that fasten it. Pin(a) is held on the side panel(B) with a metal plate. The lid panel(D) or bottom panel has a groove(e), into which the pin fits, and the pin is fastened by the metal plate(g). Rod(F) is also held on the side panel(B) with a metal plate. This rod is passed through the thin tube(c)
attached to the side panel for the shorter side, and fastened. To reinforce the assembled box, a crosspiece is attached to its outer side. This crosspiece is also used to fix the label. The lid panel (D) also has a round hollow (j), at which a nail is driven in the side panel to fix the lid. To seal the box, a piece of paper, etc. is pasted on it. The seal is covered by a crosspiece. How will this box be used in an actual situation? A number of questions spring up. Will the pins and rods fit into smoothly? Will the thin tube be held firmly with the metal plates? Will the pins be bent or lost? What feasibility did the idea have in those days when materials and labor costs were low? Because grooves are cut on the panels, the panels must be thick enough and will be heavy.

Fig.7 Pat. No.11964, 1937

Fig.8 Utility Model No.64238, 1922

Fig.9 Pat. No.163573, 1943
But the inventor explains the effects of the box as follows: "When put together, the box is strong and unlike ordinary boxes, there is no possibility of contents picked through gaps between panels. In addition, when disassembled, the volume of the box is reduced, making it easier to return empty boxes to the senders." "Because the label is fit into the side frame of the lid, it cannot be removed unless the box is disassembled. Since the crosspieces cannot be removed unless the seal is broken, the contents can be kept safe in transit." Apart from the practicality of the idea, the fundamental requirements of knock down-type boxes for transport are taken account of: among them are reduction in volume when emptied, and security of labels.

From among the ideas proposed in the 1920s, we will examine the Asahi-type knockdown wooden box, Utility Model No.64238 (Fig.8). Notified on April 10, 1922, this box was devised by H.Asahi from Kobe. It is put together with L-shaped metal frames which are fastened to the panels with nails, and then wire is used to seal it. The inventor emphasizes the security of contents as follows: "The box is firmly constructed and can stand long-distance transport. After use, the metal frames can be removed to disassemble and fold the box for returning. The box can be used for other purposes and repeatedly."

The knockdown box, Pat. No.163573, notified on April 11, 1943, is an example during World War II (Fig.9). S. Watanabe from Numazu explains his purpose as follows: "To obtain a strongly-built box very easy to disassemble without use of any metal." It was the time when people were asked to contribute any metal to the government to carry out the War, ranging from pans and iron pots to suspended temple bells. Reflecting this situation, this boxes uses ropes instead of precious iron to fix its parts. As Fig.9 shows, narrow panels are put together by dove-tail joint into a panel using crosspieces in an attempt to save resources. Bores are made on the panel and cords are passed through the bores. Loops are made with the cords on the back of the panels, and rods are run through these loops to put together panels. The bottom panel is similarly linked with the side panels using cords.

This method of using cords instead of nails to fasten the parts of the boxes also observed in the folding box, Pat. No.171984, notified on December 27, 1945 (Fig. 10). According to K. Yoshiwara from Tokyo, the inventor, the aim of the box is "To put together boxes only with cords, using no metal, hinge and latch." Binding with cords can be seen in a variety of areas of our life: for example, it is used in the framework of some houses. But this method can be observed only in a few cases in the case of furniture and furniture among them are musubi (tie up) no tukui (table), a utensil for placing food dedicated to gods that is used in Kasuga and Ise Shrines, and
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shimotoan, a table with legs made of small branches with bark\(^{11}\). Thus, this box seems to have been a revival of the ancient technology in the confusion after the defeat.

![Fig.10 Pat. No.171984, 1945](image)

Two patents and one utility model of the knockdown type are described above for each age. There are also some cases where bolts and nuts are used. Considering the situation of boxes for transport used in the 1950s and 1960s, it does not seem that the idea of knockdown boxes would be introduced much. The main reason is, as stated about boxes for transport of the stacking type, that the fact that boxes can be disassembled into pieces means that some of their parts may be lost during packaging work or in transit. If any part is lost, the entire operation will be obstructed and there will arise a number of troubles, such as the need of replenishing.

5. Evaluation of traditional transport means and innovative characters of box for transport

We have already seen the *hitsu* stored in the Culture Center of Kawanabe-cho, Kagoshima Prefecture as an example of traditional box for transport in Japan (Fig.1). From the viewpoint of the form of lids, this *hitsu* is one of the *kake-buta* form just like *nagamochi*. Unlike the *kabuse-buta* form (cover slightly larger than the box to envelop the latter), which is used for *nagabitsu* (long *hitsu*) and *kara-bitsu*, a frame is equipped inside the mouth to receive and support the cover. As a result, the chest has a better air-tightness. Crosspieces can be inserted beneath the cover to reinforce the chest, or a curved lid may be used. In other words, we may say that the *kake-buta* form was devised for the purpose of making chests larger, more air-tight and more beautiful in appearance. The *kabuse-buta* form has the

limitation of size: if thicker panels are used, the lid may become stronger, but
the weight and cost will increase. To cope with this problem, people probably
devised the insertion of crosspieces to reinforce the strength of the lid. But
when a crosspiece is equipped inside the lid of a kabuse-buta form chest, the
crosspiece will come in contact with the top edge of the chest and clatter.
But a frame is attached inside the mouth, the frame will support the cover
frame and the crosspiece does not touch the top edge of the chest; in this
case, no clattering will occur.

Fig.11 construction of hitsu
(Kawanabe-cho)

Fig.12 mechanism of removable hinge

Fig13 construction of cover

Every time when cover is placed on the chest, it strikes the mouth frame,
giving it a shock. If the frame is fixed only with nails, it is apt to come off
due to the repeated shock. To prevent damage to the frame, the chest has a
bracket on the end panels, which give support to the mouth frame. This
bracket is not found in the boxes of the kabuse-buta form, san-buta and
inro-buta (cover identical in plan with the box, their mouths being halved in
thickness to fit each other) form. It is rarely seen in nagamochi for which
the most important factor is beautiful appearance, since brackets, if
provided, will obstruct the molding of the edge.

Most of the examples shown above are constructed, employing the
layer-joint system. This kind of system is largely adopted for the
manufacture of boxes in Japan, ranging from the ancient yamato bitsu
(Japanese style chest) to nagamochi. But this system is rarely observed in
Western Europe and in neighboring countries. The reason is unclear, but
traditional technology has probably an important role.

Now we will examine the structure of the bottom. Because the weight of
the contents is all applied to the bottom, its structure is important especially
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to boxes for transport. But there have not been very good ideas; in Japan, the *uchitsuke-soko* (fastened bottom) method is the most popular. Based on this method, a new system was devised: battens are provided along to the edge of the bottom panel (Table 1). Since the battens hold the bottom panel, the box with them is stronger than one without them. It has some other advantages: this box is more stable, and because it is capable of keeping an opening between the bottom and the floor, it can protect contents from moisture and insect injury. In some cases, bores are made on the battens to pass cords through them for carrying or binding the box. The cover and the box are linked with removable hinges, and if the cover is moved laterally, it can be separated from the box body.

Summing up, boards thick enough to have the required strength are used for the traditional box for transport shown here and brackets and battens are employed to reinforce the strength. The box has no frills, such as corner and hanging metal fittings. Proper joinery is applied to obtain air-tightness. This box can be stacked, while a person can carry either one of the box or two by hanging them on both end of a bar. The box is also lockable.

![Fig.14 stacking of nagamochi](image1) ![Fig.15 chemist's kouri(Museum of wicker)](image2)

But this traditional box for transport does not satisfy the technical goal of reducing its size when emptied. In Japan, this goal has been achieved by stacking. According to an interview with a craftsman from Okawa, Fukuoka Prefecture, who used to be engaged in the manufacture of *nagamochi*, around 1910 to 1930, *nagamochi*, large-sized boxes, were shipped from the city's Port of Wakatsu port consuming areas in a large quantity after their volume was reduced by stacking and packaged in straw mats. This story, combined with the fact that as described in "Lumber Use for Craftworks" published in 1910(12), *nagamochi* had three standardized sizes, large, medium and small, in Tokyo and other districts, suggests that the stacking system was adopted.
not only because of prices and convenience in use but also to reduce the volume for transport. Fig.14 shows this situation. The chemist’s kouri that was used by medicine peddlers from Toyama Prefecture also adopts the stacking system. To prevent sales records and stationery and a variety of medicines from being made a mess of, the kouri consists of five to six smaller kouri in different sizes (Fig.15).

The kumitate system was adopted in the chest making process. There was a community of joiners in Naraya-machi along the Awa-Horikawa River, Osaka, where the production of chests and boxes was concentrated. "Kebukiso" published in 1645 described as follows: "The joiners in the community cut the parts of chests and boxes and used gimlets to bore holes in the parts so that they could be put together into boxes, and shipped the parts to the markets." Later in the early 20th century, craftsmen in Okawa processed lumber into the members of nagamochi ready for assembly and stored them as they were during the rainy season. Then in fall, the popular season for wedding ceremonies, they put together the members into finished products and shipped to the market (nagamochi used to be a must in a wedding ceremony as the container of the bride’s bedclothes and allied belongings). As these examples indicate, the kumitate system was used in the production process.

Fig.16 wooden container(Nipon Express Co.) Fig.17 duralumin container( :)  

Now we will study the folding system which is adopted in most of the patented boxes. No example of traditional boxes for transport using this system is available, but I suppose that the concept was rarely employed in these boxes. The traditional concept of boxes is a container with a lid on the top. I do not imagine that the Japanese had had the idea of any folding box until the Meiji-era. It is true that there were some nagamochi of the kago

(12) Department of Forest, Ministry of Agriculture and Forestry, "Lumber Use for Craftworks" 1910, p.281
(basket) type with a mouth not only on the top but on the front whose half could be opened. But this front door was devised for convenience in use, not for reducing volume when returned empty. In this sense, the idea of folding adopted in patents was an innovative one.

As noted already, we may say that the innovation was possible by the use of hinges. In Japan, too, metal fittings were used as the devices for opening and closing the cover, as observed in the kara bitsu stored in Shoso-in that dates from the Nara period (646-794), these metal fittings consisted of L-shaped ones known as hiji-kanagu and ones known as tsubo-kanagu (Fig.12)\(^\text{13}\), the latter having an eye on their ends through which the former are run through. This combination of metal fittings had consistently been adopted until the nagamochi of modern age. Their characteristic is that the lid can be removed if it is moved horizontally. In other words, the lid can be taken off just like shoji (paper sliding door) and fusuma (another type of paper sliding door). By contrast, hinges are fastened with wooden screws and cannot be removed easily. And needless to say, locks have the function of providing a firm union of the cover and the box. Thus, when hinges were introduced to boxes for transport, the fundamental idea switched from an easily removable to firmly fixed one, denying the traditional concept.

6. Conclusion

Formerly, chests were transported manually, whether in wedding processions and sankin-kotai or in commercial transport of goods. Manual transport was hard labor, but its quality was probably good; in other words, cargos were probably treated carefully in most cases. But in the free trade of modern age, efficiency was the most important element, and boxes for transport, which were now handled by far more, unidentified people, were dealt with less care naturally. In addition, the distance and means of transport were growing greater, and because of this greater efforts were made to improve the function of boxes for transport to protect contents. The goals were reduction in volume when emptied and reinforcement of structures mentioned in the patents quoted earlier, such as strength, durability, rigidity, prevention of deformation, simplicity, prevention of breakage, light weight, air-tightness and sealing up. These characteristics are structural ones and hard to distinguish from manufacture. Other noteworthy factors are sealing of labels and other devices for preventing pilferage and mass-production function. I wish to examine these features in the future.

One of the purposes of this paper is to correct the opinion of Kosaku Katayama, who stated that the development of containers in Japan was based on the reports from some commercial attaches at the Japanese Embassies and Legations abroad, which were introduced to the then Ministry of Railways around 1926. I think that this purpose has been achieved by describing in detail the fact that there had been a considerable accumulation of knowledge about containers by Japanese themselves already in the early days of the Patent Law.

Bibliography

Junichiro Narita "Dictionary of technical terms for wood work", Riko-Gaku-sha, 1976

輸送用荷箱にみる伝統技術の変容

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わが国では、近世、参勤交代や婚礼行列、旅行や商業活動をつうじて、各種の運搬用の箱類が発達した。それらの中に、くり返し運搬に使用されたと考えられる中型の箱がある。それは、蓋裏や底裏に強化と運搬用の紐をとおすために棧を挿入した、気密性の高い独特な掛け蓋型の箱である。さらに、蓋を開け閉めする際に、開口部の枠材に蓋枠が当たる衝撃を短側面を前方に突き出して持ち運びを形成することによって対処している。側板は伝統的な細手接ぎで、装飾的な隅金具、吊り金具などない。蓋は平なので積み重ね可能で、施錠もできる。棒に吊るして一人で２個運搬したり、１個を背負ったりして運んだ。

一方、明治以降の輸送用の箱についての特許および実用新案を検討すると、堅固、堅牢、剛強、変形防止、簡単、破壊防止、軽量、気密、密閉などが追求されたことが知られる。そして、簡易な構造・操作による空箱の容積縮小が重要な技術目標とされ、「折りたたみ」「組立」「組合」のアイデアが数多く提出された。それは反復使用される輸送用荷箱にとって、空き箱の容積縮小が重要だったからである。さらに、箱（車）積みにした際、コンパクトに積めることも配慮された。そのアイデアのほとんどは、螺鈿の工夫によって実現したといえどもよい。
わが国の伝統的な荷箱も、螺番を使用したとはいえ、蓋と身は障子や絹のようにはずれる形式である。いうまでもなく、頑丈な箱は蓋と身の強固な連結によって達成される。連結金具においては、着脱式から拘束型へと伝統的なアイデアが否定されたとみることができる。また、わが国では、空箱の容積縮小法は、長持の規格や乗荷行李にみられるように「入れ子方式」がとられてきた。生産段階では、箱立式がみられ、使用の便のために蓋だけではなく、前板が倒れる開放的な構造の箱が作られたものの、返り荷のための容積縮小をはかった折りたたみは、明治期までなかったのではないかと考える。

新しいコンテナは、第2次大戦以降日本通運によって実用化される。それは、輸送される量や距離や手段が飛躍的に拡大し、効率が追求されるという社会・経済的状況下で起こったものである。その契機は、大正15年頃、海外駐在の大・公使館の商務官からもたらされた報告だと片山幸作氏は述べておられるが、特許法にみるかぎり、その初期から日本人による数々のアイデアが提示され、蓄積されてきたことを指摘した。