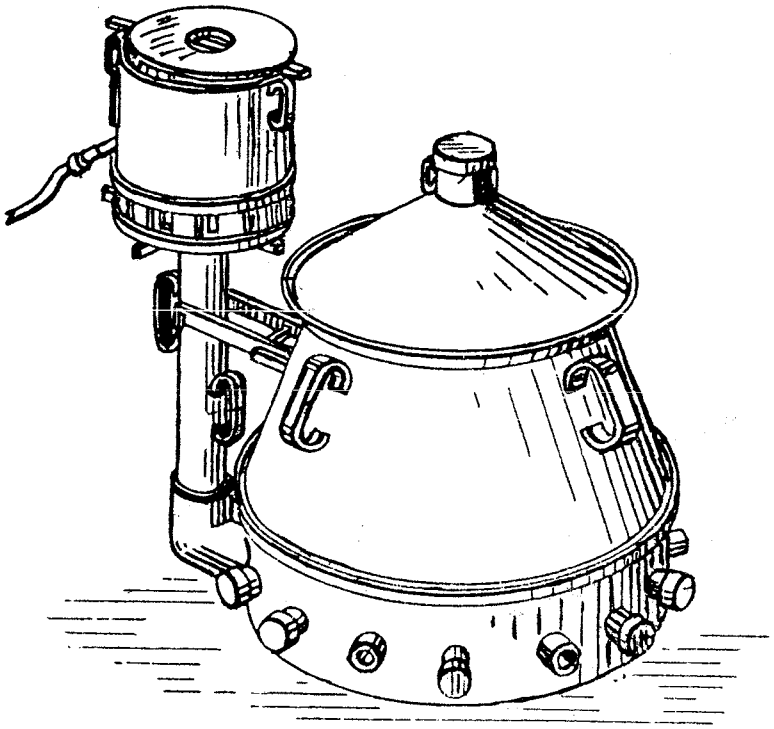
Charcoal Making
NEWTON'S Method

J. J. Newton



INTRODUCTION

The writer assumes that most readers of this booklet know very little if anything about charcoal making. Therefore, I will present a little historical data and bits of information that I believe anyone wanting to make charcoal should know before he or she starts.

Charcoal making is an art that has to be learned by doing. The quality of charcoal varies depending on the apparatus or method used, the nature of the wood used, local climatic conditions and other factors.

The process of converting wood into more or less pure carbon has been in use dating back to ancient times. Primitive methods accomplished carbonization by burning dry wood under cover of green branches, sod and dirt so as to restrict the flow of oxygen to the fire and produce a slow charring of the wood. Charcoal making today is still based on the same principal: Control of the oxygen supply and causing slow combustion of the wood.

More efficient ways have been devised to make charcoal and obtain other by-products from the carbonized wood: Acetic acid, methanol, tar and gas. Some of these methods employ the use of large brick ovens, cinder block houses, metal kilns and retorts and complex distillation plants costing millions of dollars.

This booklet deals only with the "Quality Lump Charcoal" that I have been able to produce and sell at premium prices using my self-designed small sheet metal kiln. The operating principals are shown in various drawings and described on the following pages.

LEARNING HOW TO MAKE CHARCOAL — EXPERIENCE

You might ask; How does a "Greenhorn" become proficient in making charcoal?

I became interested in charcoal making years ago and read everything about the subject that I could get my hands on. I contacted the U.S. Department of Agriculture, Forestry Division, Madison, Wisconsin and asked for their advice as to how I could get involved in making charcoal. It was suggested that I contact the Forestry Division of the State of New Hampshire, because they had experimented with various ways of making charcoal and had been able to make some of the best quality charcoal in the country. I wrote and received a number of articles on the subject from the New Hampshire Forestry Service. After reading up on charcoal making and absorbing all that I could, I built my first kiln based on their design that produced a high quality charcoal as claimed.

Basically the "New Hampshire Kiln" was a two part metal cone shaped unit with air inlets and smoke stacks evenly spaced around the bottom perimeter of the kiln. The unit was hoisted and set down over a previously stacked pile of wood that was to be cooked into charcoal. Their kiln was designed primarily to make charcoal out of short hardwood logs, approximately 4′ long, with a diameter of 2″ to 6″. However, in my experiments, I found that the metal would buckle and become very distorted around the air intake ports, because of the heat generated by my usage of other types of hardwood: kiln dried scrap wood, dried slabwood and smaller pieces of chunk wood. Consequently, I redesigned my own kiln with the goal in mind of keeping the high quality charcoal produced in the New Hampshire kiln.

"Newton's Kiln" is the result of approximately 20 years of experimenting and redesigning with the main objective of making "High Quality Lump Charcoal."

Another objective of my kiln is to provide a gas and smoke burning attachment for use in the production of charcoal whereby charcoal may be produced without creating excessive air pollution.

Other objectives of the design are to provide durable kiln life, ease of operation, flexibility in the wood usage as to size and form and efficient production of charcoal.

KILN LOCATION

The location of the kiln site is important. A place in the country where its operation will not conflict with any local or state laws is the usual location

for this type of operation. It is preferable to locate the kiln in an area at least partially surrounded by trees, which help break up the wind. It should be operated on level ground. My small operation takes less than two acres of land for wood storage and kiln sites on my forty acre plot in the country.

USES OF CHARCOAL

Charcoal has been used for many purposes: the smelting of iron in blast furnaces, for household heating and cooking, for filtration and deodorizing purposes. There have been and still are many other uses for charcoal. My kiln was designed specifically for making charcoal to be used for barbecuing outdoors or indoors. CAUTION—Indoor usage of charcoal should never be attempted unless the room or space has been properly vented, as the carbon monoxide gas generated when making charcoal and in cooking or heating with it can be lethal.

WOOD FOR CHARCOAL MANUFACTURING

Charcoal may be made from any kind of wood, either hardwoods or softwoods. However, the two should not be mixed in the same batch as the more porous softwood will be consumed if mixed with the denser hardwoods; softwood charcoal is lighter in weight for the same bulk than hardwood charcoal. I have experimented with making charcoal from softwood, but I am currently using only hardwoods because I am in a hardwood growing area and the demand is good for the hardwood charcoal produced.

WOOD QUALITY

Rotten wood should be avoided as it does not produce good charcoal. Branch wood that is excessively crooked and wood with a high percentage of bark does not produce good charcoal. Bark carbonizes but produces inferior lumps and easily disintegrates into fines. Whenever possible I use debarked wood which produces a cleaner good quality charcoal.

SEASONING

Wood should be thoroughly seasoned or dried before using. Wet wood or green wood can be carbonized if enough heat is developed to dry the wood, but it takes so much longer to make charcoal and the yields are usually smaller so that it is not advisable to use.

Fresh cut green wood should be stacked in piles off the ground, over at least one summer season. A one-year supply of wood should be on hand before the start of your yearly charcoaling season. The key words for good and efficient charcoaling are "Dry Wood." This is a "Must"; keep the wood covered, keep it dry.

SIZE AND TYPE OF WOOD

I have used all of the following types of wood in my kiln with good success: Kiln dried scrap from dimension mills or furniture factories, air dried slab wood, chunk wood (split) and small (6″ Maximum diameter) short logs.

TEMPERATURES NEEDED TO PRODUCE CHARCOAL

From what I have read and from what I have found out by my own experiments, the operator of small sheet metal kilns such as mine does not have to concern himself unduly about temperatures generated in the kiln: That is to say, he does not need to have any special gauges or temperature control devices in order to make good charcoal. You find out very quickly from experience when the right amount of heat has been generated and how to sustain that heat.

Again from what I have read, as the temperature rises, a point above 518 degrees is reached where a reaction takes place that starts the carbonization process which will continue without further addition of heat (assuming the wood to be dry). A heat transfer takes place from one carbonizing piece of wood to the next. The higher the final temperature, the higher the carbon content of the finished charcoal.

YIELD OF CHARCOAL PER BATCH

There are many variable factors affecting the amount of charcoal produced in any one batch: The density of the species of the wood used, heavy dense wood like hickory and oak produce heavier charcoal than ash or cherry.

The size of the wood and the way it is packed in the kiln affect the yield. The tighter the wood is packed or the more volume of wood that is put into the kiln leaves less air space, and consequently more charcoal should be produced.

The weather conditions and the moisture content of the wood affect the yield. In the charcoal making process part of the wood charge in the kiln is being consumed in heating the kiln to the high temperatures needed to drive off the moisture and gases before changing into charcoal. The higher the moisture content of the wood, the more wood will be consumed and the lower the yield will be. High winds cause excessive draft and more wood is burned. Cold and rainy weather hinders combustion and requires more heat, which consumes more wood.

The skill of the kiln operator affects the yield. He must adjust the oxygen input during the cooking cycle to maintain the desired high temperatures necessary to produce a light-weight purer charcoal. He can tell with a little experience when the cooking is going along nicely just by the feel of the heat radiated from the kiln. He must know when to shut off the oxygen supply and seal the kiln so that it is air-tight at the end of the cooking cycle.

My best yields have been from oak and sugar maple. Small pieces of kiln dried scrap wood are best. The smaller, fairly consistent size of this wood allowed the charge of wood to pack tightly together and consequently I was able to get good yields, between 800 and 900 pounds per batch on the average, from my larger kiln. The yields of charcoal from chunk wood of mixed hardwoods, cut in 12″ short lengths and split into small wedges of about 3″ consistently yielded between 700 and 800 pounds of baggable screened charcoal. Debarked slabwood purchased by the truck load which had been cut into about 15″ lengths were air dried for about six months. The slabwood produced between 500 and 600 pounds of charcoal per batch. Smaller cuts with some splitting of the wood and careful placement when filling the kiln should give better yields. The usual taper of the slabwood results in more air space when casually throwing the slabs into the kiln when loading the charge of wood.

Many of the adverse effects on the yield of charcoal mentioned in the preceding paragraphs have been abated in the design of my kiln. My kiln design makes it very easy to operate. By following a few basic instructions, even an inexperienced teenager or older retired individual can operate my kiln.

I redesigned my kiln again recently, adding some improvements which were not shown in the drawings on Figure 1 and Figure 2. Consequently, I made a drawing of my own which illustrates the added improvements in my kiln "Shut-off and Exhaust System." Please refer to Figure 3 and the details of this system under the symbol "H."

I wish to point out that the symbols and descriptions of the various parts illustrated on Figure 1 and Figure 2 also apply to like components illustrated on Figure 3.

DESIGN:

FIGURE 1—Is a perspective view of the kiln showing its principal external features as well as the exhaust system utilized during the normal charcoal making period.

FIGURE 2—Is a vertical sectional view illustrating the smoke outlet utilized during the normal charcoal making period. It also illustrates other internal and external design features not shown in Fig. 1.

FIGURE 3—Is also a vertical sectional view illustrating the new improvements to the exhaust system not shown in either Fig. 1 or Fig. 2.

Section "A"—Bottom Cylindrical Section, open at the bottom, which rests on the ground or on a previously prepared foundation of cement or firebrick.

Section "B"—The Cone Shaped Middle Section, which seats into a channel formed around the top perimeter of the bottom section.

Section "C"—Conical Cover Section, which seats into a gutter formed near the top outer perimeter of the middle section.

ACCESSORIES:

The **Cap "D"**, which is provided with a loop handle, fits snugly over the central flue pipe neck "C-1."

The **Central Flue Pipe "C-1"** is the outlet neck cut thru and welded into the top center of the cover section "C."

The **Exhaust Pipe "E"** is welded into the bottom section "A" at near ground level.

The **Exhaust Stack "E-1"** (Fig. 1 and Fig. 2) seats into the exhaust pipe "E" allowing for the passage of moisture and gaseous materials during the cooking cycle.

The **Combustion Chamber "F"** is an open ended cylinder with built-in air adjustment ports. An ignition torch "F-1" projects through the body of the chamber "F" and the inlet end of the torch is adapted for connection with a combustible gas supply source. The chamber "F" also has a closable access port thru which the ignition or pilot torch "F-1" may be lit when desired.

Projecting **Support Arms "E-2"** are welded to the stack "E-1." A 1/8″ thick sheet metal plate slightly larger than the diameter of the combustion chamber "F" has an opening cut thru its center just large enough to fit down over the 10″ stack "E-1" and rest on the support arms "E-2." This round plate "F-5" then becomes the floor of the combustion chamber "F."

Two pieces (only one piece shown in Fig. 1) of 1/8″ x 1″ flat bar approx. 2-1/2′ long "F-2" are laid across the open top of the combustion chamber "F." These bars support another circular 1/8″ sheet metal plate with an 8″ hole cut in its center "F-3." This cover for the combustion chamber "F" is slidable in any direction and retards the gases and smoke coming out of the stack "E-1" long enough to mix with the oxygen allowed into the chamber. The ignition torch "F-1" lights this combustible mixture which is substantially burned so as not to create an excessive air pollution problem.

The **Air Inlet Tubes "A-1"** are welded thru the wall of the bottom section "A" at near ground level. The tubes are evenly spaced around the kiln to permit the input of air or to close out the air entirely as desired. Removable caps are used for air control and shut-off purposes.

Firebrick "A-2" completely lines the interior wall of the bottom section "A" while surrounding the air tube inlets which protrude into the kiln chamber.

The **Steel Mesh "A-4"** is removable. Its purpose is to prevent the wood and charcoal in the kiln from clogging the exhaust pipe.

The **Fire Cage "G"** is centered within the kiln bottom section "A." It has an open bottom with a circumferential steel ring as its base. The cage is defined by a series of upwardly convergent rods or bars secured by a smaller ring of steel at the top. This cage is used to contain the starter (wood fuel) which heats the material within the kiln being converted into charcoal.

The **Fire Cage Extension "G-1"** is simply a piece of pipe or a perforated cylinder used to keep the wood charge within the kiln from caving or falling into the fire cage "G" during the initial cooking cycle.

The **Channel "A-3"** is welded around the top of the bottom section "A." This channel is used to keep the kiln air-tight at the point of contact with the middle section "B" which will be seated into this channel. The channel at the appropriate time will be filled with sand which will be used as the sealant. (SEE DETAIL Channel "A-3")

The **Drip Flange "B-1"** is welded to the inside circumference of the middle section "B" near the bottom edge. This flange points downward causing any tars or other liquid matter to by-pass the sand sealing channel "A-3" and drop down into the bottom of the unit where it will be dissipated.

Another **Drip Flange "C-2"** performs the same function as the "B-1" flange.

The upper edge of the middle section "B" includes an upwardly and outwardly directed circumferential flange "B-2" on its outer surface defining a gutter. This gutter will be filled with sand which is used as a sealant the same as with "A-4." (SEE DETAIL Flange "B-2")

Three **Lifting Eyes "B-3"** are evenly spaced around the top of the middle section "B" for the purpose of lifting and moving this section as desired.

The **Lifting Eyes** at **"C-3"** and at **"F-4"** are also used for moving purposes when necessary.

The **Double Brackets "E-3"** (Fig. 1 and Fig. 2) are removable. They are used to hold the exhaust system steady. It is preferable, however, to attach the exhaust system to a nearby pipe or pole (as I now do with my latest model kiln illustrated in Fig. 3), otherwise the exhaust system must be disassembled in order to move middle section "B."

Another Cap (not shown in the drawings) similar to Cap "D" is used to cover the smoke stack "E-1" at the end of the cooking cycle to seal the stack and kiln when using the earlier model kiln illustrated in Fig. 1 and Fig. 2.

Lifting Loops "E-4" are used when hoisting stack "E-1" while assembling or disassembling.

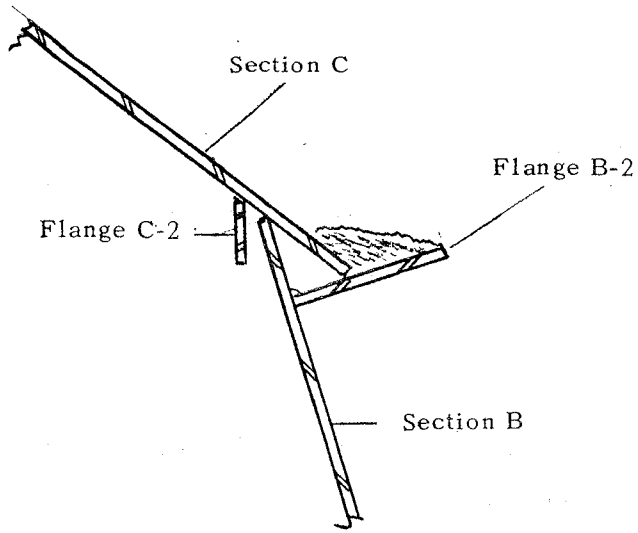
The **Kiln Shut-off System "H"** as illustrated in Fig. 3 is the method I use on my latest kiln.

The Condenser "J" is an experiment that I tried with some success. It is an air-tight cylinder thru which the smoke, gases and other vapors pass before entering the stack "E-1." Its purpose is to condense as much of the moisture as possible contained in the vapors passing thru its chamber. A hole is cut thru the bottom of my condenser and any liquid matter passes thru into a collection pit beneath the condenser.

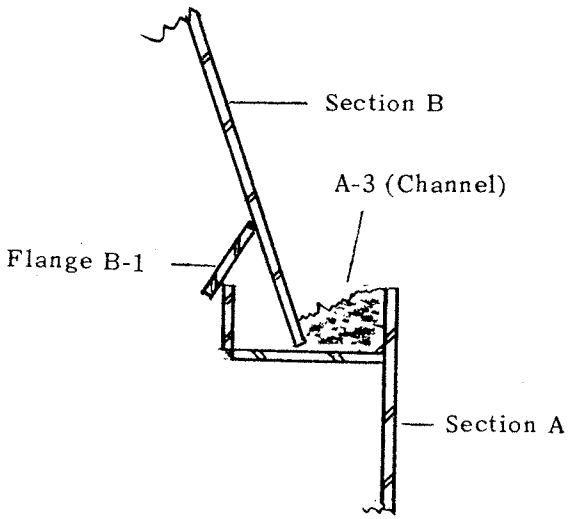
"J-1" is a clean-out access tube and cap similar to the "A-1" tubes and caps.

"E-5" Collar is welded around the bottom of the stack "E-1" to act as a stop or seat and also to keep rain out. Sand is also placed around and on this collar to make the joint air-tight.

Detail - Flange B-2 (Gutter)



Detail - A-3 Channel



CONSTRUCTION:

The kiln is of welded construction throughout. Principal materials for the Bottom Section "A" is 1/4" sheet steel for the shell, 4" short threaded pipe nipples for the air intake tubes "A-1," with caps for shut-off purposes. Firebrick was laid to form the interior wall of the bottom section.

Sections "B" and "C" were constructed of 1/8" sheet steel.

The various lifting eyes were constructed of 5/8" round bar forming openings of approximately 3" to accommodate hoisting hooks.

The exhaust stack was made from 10" I.D. standard pipe.

The combustion chamber "F" may be made from 1/8" sheet metal.

DIMENSIONS:

The kiln dimensions need not be exactly as given here. Good charcoal can be made by following the principals described here even though the overall dimensions are smaller. My latest model kiln has a 10" smoke stack; my previous model utilized an 8" stack because the overall dimensions were smaller.

Fig. 1

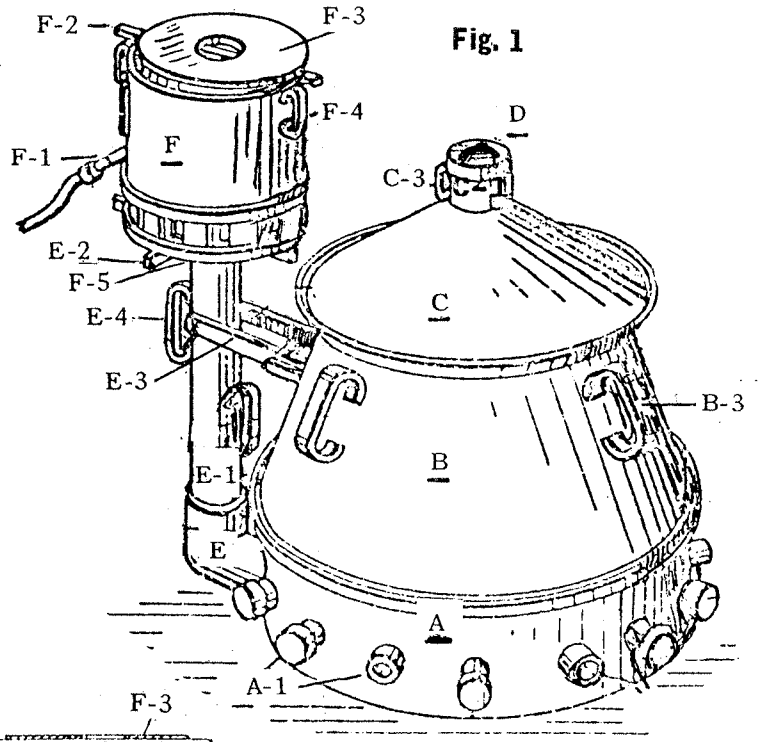


Fig. 2

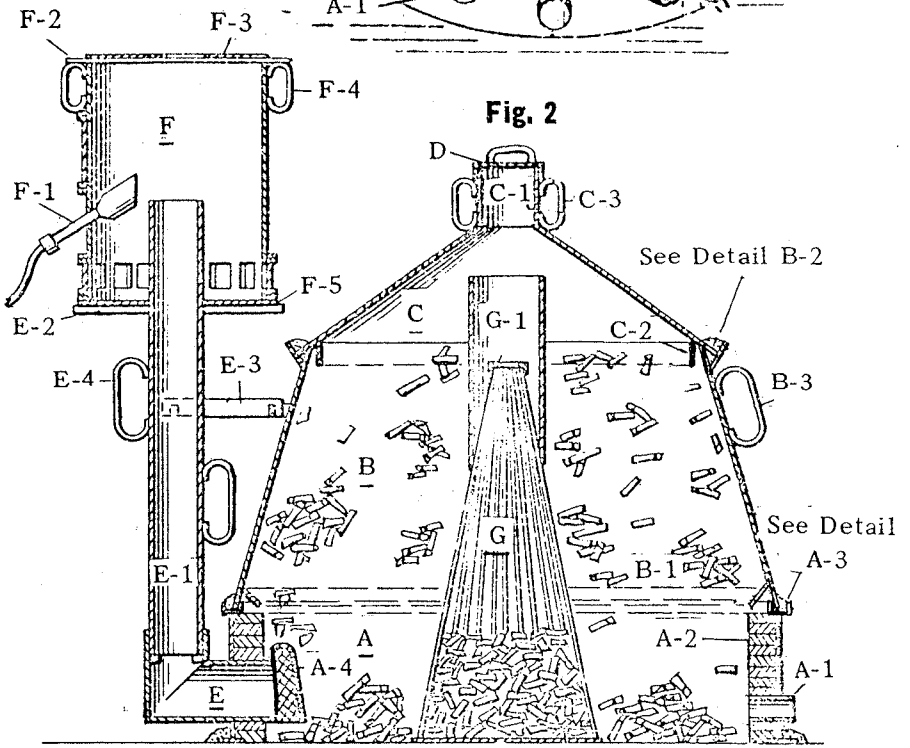
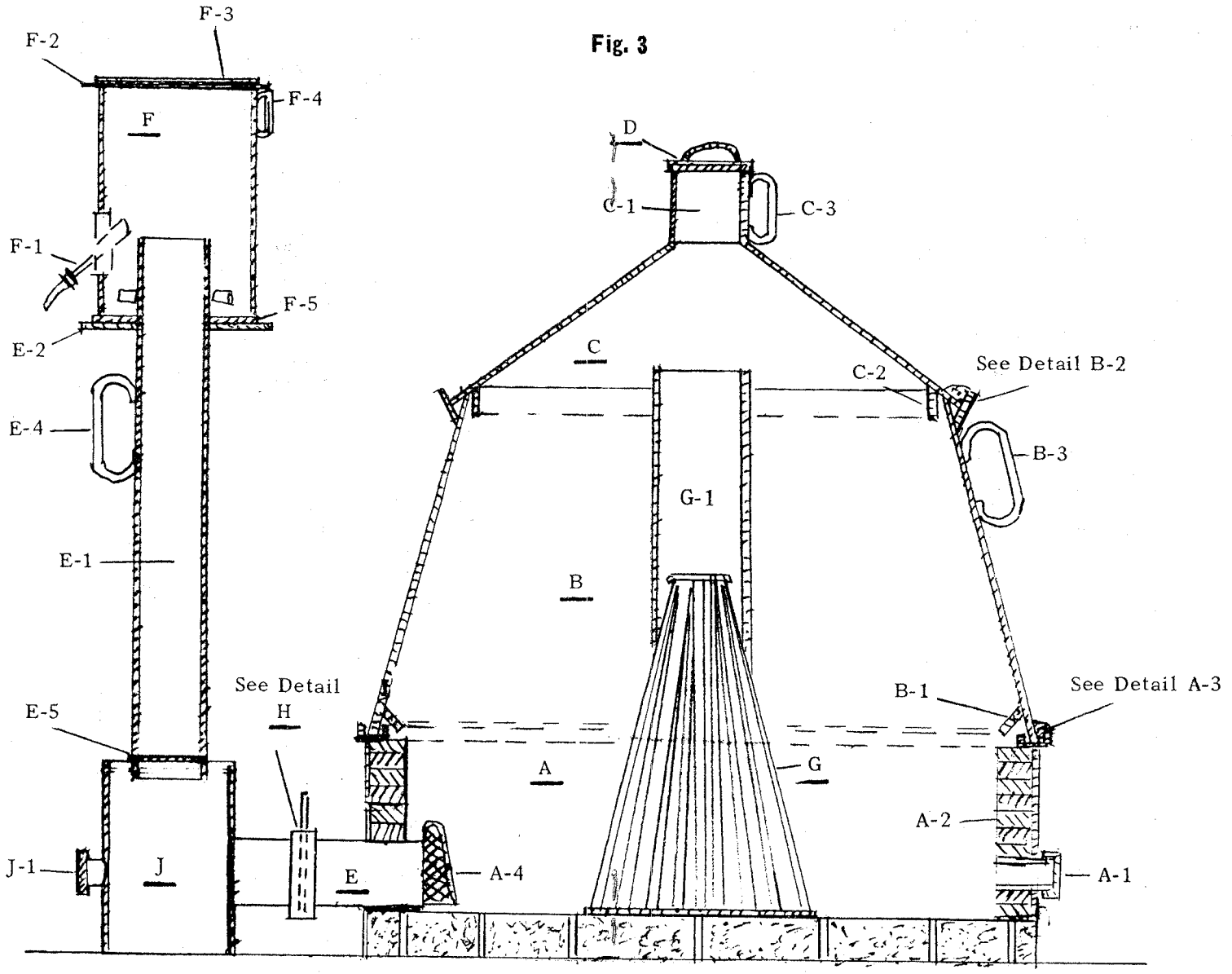
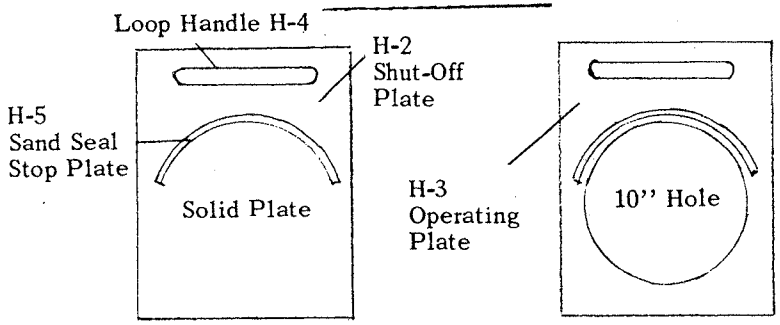


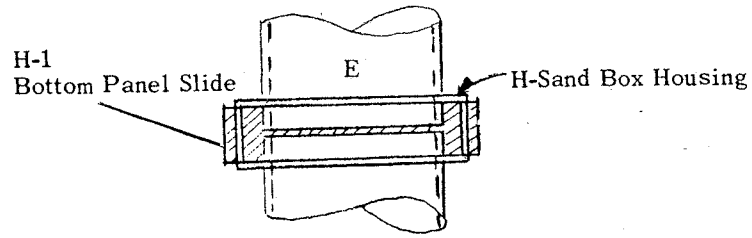
Fig. 3


F-3
F-2
F-4
F
D
C-1
C-3
F-1
F-5
E-2
C
C-2
See Detail B-2
E-4
B-3
G-1
E-1
B
See Detail
H
B-1
See Detail A-3
E-5
A
G
A-2
J-1
J
E
A-4
A-1

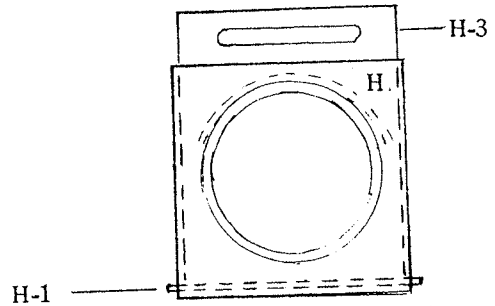
KILN SHUT-OFF SYSTEM DETAIL



Horizontal Sectional View



Vertical Sectional View (Operating Position)



The model that I describe here is the largest unit that I have used:

The inside diameter of Section "A" is 90″. The height along the side is 30″.

Section "B" has a diameter of 96″ at the base and 60″ at the top, the height along the side being 42″ vertically.

Section "C" adds another 15″ of vertical rise to the point where it is joined to the Flue Pipe "C-1." It has an overall diameter of 64″.

The Central Flue Pipe "C-1" is 8″ high with an 8″ inside diameter.

The height of my 10″ stack "E-1" is on an approximate level with the top-most part of my kiln at "C-1."

The combustion chamber "F" is approximately 2′ in diameter by 3′ high. The cover "F-3" is about 26″ in diameter.

The fire cage "G" is about 2′ in diameter at its base with a vertical height of 4′. It has a 4″ opening at its top. The extension "G-1" is a short piece of 8″ pipe sitting on top of the fire cage "G"; it extends upward to approximately 2″ above the top level of the middle section "B."

DIRECTIONS FOR OPERATING "NEWTON'S" KILN

The following data is based on my many years experience operating my kilns of various sizes, using the types and sizes of wood mentioned in previous sections of this booklet. Wood has been kiln dried or well seasoned for the most part, usually a year or more having elapsed since cutting the wood.

Assuming that the kiln is complete and ready for use and that some means of lifting and lowering the various sections of the kiln is available, a supply of seasoned wood and certain tools and supplies are all that is required.

EQUIPMENT AND SUPPLIES

The following equipment and supplies should be on hand before starting:

Equipment

A square shovel for charcoal shoveling
A round pointed shovel for shoveling sand
A round shovel with no handle (use as a scoop)
Short ladder to reach top of kiln
Old broom for sweeping away sand
Rake
Axe
Sledge hammer
Barrels or tubs to hold kindling and brands
A steel poker about 5′ long, 1″ diameter
1 Doz. + pieces of 8″ x 8″ x 1/8″ steel plate (dampers)

Supplies:

Clean fine sand for sealing kilns
Matches or lighter
Barrels of water near kiln (in case of fire)
Asbestos or heavy gloves
Scales for weighing bags
Bags for charcoal packaging
Twine for tying bags shut
Kerosene (to light starter fuel)
Kindling or brands of charred wood (the starter fuel)
A clipboard, pencils, paper if records are to be kept

LOADING THE KILN

Refer to Fig. 3—The kiln is completely assembled here.

Step #1—Using a hoist of some kind, lift and remove the Cover Section "C" and the Middle Section "B," setting them aside out of the way.

Step #2—The bottom section "A" interior is now exposed.

a. Place the Fire Cage "G" in the center of the bottom section.
b. Fill the fire cage "G" with starter fuel (preferably charred brands and bits of charcoal from previous batches).
c. Place your raw material wood, to be converted into charcoal, in the bottom section surrounding the fire cage. Heap it up as much as you can without covering the top of the fire cage; also keep the channel "A-3" free of material.

Step #3—Hoist the Middle Section "B" up over the fire cage and partially filled bottom section into position seating it into the channel formed at "A-3."

Step #4—Put the Fire Cage Extension "G-1" into position on top of the fire cage. Complete the loading of raw material into the middle section, heaping it up around the fire cage and extension as much as possible above the rim of the middle section while keeping the gutter "B-2" clear of material and allowing room for the cover "C" to fit properly.

Step #5—Hoist the Cover "C" into position centered in the gutter "B-2" while clearing the drip flange "C-2" allowing it to be properly positioned.

Step #6—Seal the Channel "A-3" and the Gutter "B-2" with sand so as to make them air-tight. LOADING IS NOW COMPLETE.

LIGHTING THE KILN

Refer to Fig. 3 and the detailed drawing of the "Kiln Shut-off System" **H.**

Step #1—Assuming that the "Sand Box Housing" **H** is empty of sand and that all removable parts have been disassembled:

a. Insert the "Bottom Panel Slide" **H-1** into its guide supports closing the bottom of the housing.
b. Place the solid steel "Shut-off Plate" **H-2** into the shut-off slot within the housing until it rests on the "Sealing Stop Collars" **H-5.**

Step #2—Open **four** of the "Air Inlet Tubes" A-1 on the side of the kiln opposite the stack and exhaust system. Do this by removing the "Caps" therefrom.

Step #3—Using a ladder, climb to the top of the kiln and remove the "Cap D." Next take matches, a wad of paper and a pint of kerosene to the top of the kiln. Dip the paper wad slightly into the kerosene. Carefully pour the pint of kerosene down thru the "Flue Pipe C-1" and thru the "Fire Cage Extension G-1" so that it thoroughly saturates the upper contents of starter fuel contained within the "Fire Cage G." Next light the wad of paper and drop it so that it rests on top of the saturated fuel in the fire cage. A ROARING FIRE SHOULD SOON DEVELOP.

The fire now burning within the "Fire Cage G" should be allowed to burn uninterrupted for approximately two hours. During this period the heat within the kiln will be building up in intensity to the point that is necessary in order to make charcoal.

Also during the initial two hour period of the cooking cycle, smoke and gases will start to be released from the charge of raw material within the kiln. So as not to become a nuisance nor create an excessive air pollution problem you may want to do as I have done to alleviate this problem:

You have various choices. You may want to rig up a combustion chamber system similar to that which is shown used in the drawings Fig. 2-"F," or you may wish to use this simple method as I do:

Take a steel drum and remove both ends, cut a little larger than fist size hole thru the wall of the drum about 1/3 of the way up from one end. Take a drum cover and cut an 8″ dia. hole in its center. You will also need 2 pcs. of flat bar 1/4″ x 1″ x 26″ long.

As soon as possible after lighting the kiln place the open-ended drum, centered on top of the kiln, over the open flue pipe "C-1." Next place the two 26″ long flat bars across the top of the open drum, then put the drum lid with the 8″ hole in its center on top of the two flat bars which will be the slide support for the cover.

Assuming the wood is properly dried, you may only have to apply a lighted torch to the hole cut into the side of the drum as previously described. The smoke and gases emitted from the kiln after about fifteen minutes or half hour are usually combustible enough to ignite and burn unaided without a pilot light continuously in operation. However, if this doesn't work be prepared to rig up a pilot light to insert through the hole in the drum. Propane or natural gas may be used for the pilot light if available. Oxygen input to mix with the gases is obtained by shimming up the lower end of the drum, where it rests on the kiln, allowing oxygen to enter the chamber.

TENDING THE KILN

During the first hour after lighting the kiln no adjustments are needed to the air intake ports. After the first hour, periodic probes into the kiln thru the air tubes "A-2" using a steel poker should be made. (The poker is a very necessary and important tool aid, with it you must be able to judge how the cooking process is coming along. This is done by feeling the uncooked wood when probing, or in finding no resistance which may mean you are poking air and have burned up too much wood.) Be cautious in using the poker so as not to damage the fire cage "G" by poking in too far; the metal will bend because of the heat.

As you approach the two hour mark in the initial cooking period and you begin to see red-hot coals showing in the kiln thru the air intake ports and the poker tells you that there is little if any wood resistance, it is time to make adjustments in air input.

Let us assume that one and three quarter hours have elapsed since lighting the kiln. There are red-hot coals showing at three of the four air inlet tubes, with the middle "hot hole" indicating little if any wood resistance when probing with the poker. I would take a "Pipe Cap" "A-1" and shut off the hot middle hole completely. I would take three of the 1/8″ x 8″ x 8″ "Damper Plates" listed under equipment and lean them over and against the other three open air inlet tubes so as to restrict the amount of available oxygen. Instead of the wide open 4″ dia. hole I would cover the hole so as to leave only about an inch opening for air to enter. I would immediately also open two more air intake ports, the nearest closed port to the left and the other nearest to the right. At this point the two hour initial cooking period would be about reached which would require a major change in procedure.

This is what I call "Switch-over Time": That is, up to now we have not been making charcoal as it should be made; instead, we have been building up the heat within the kiln to the degree necessary to convert the wood to charcoal. If we continued in the same manner for a long period of time, we would develop a very hot fire which would burn up the wood material to ashes just as any stove or furnace would do.

Refer back to Fig. 3 and turn to the page showing the details of the kiln "Shut-off System H."

Step #1—We remove the "Solid Shut-off Plate H-2" that up to this time has prevented any of the smoke, gases or other vapors from coming out of the kiln and up thru the chimney stack and exhaust system. We insert in its place the almost identical plate with the exceptional feature: This "Operating Plate H-3" has a 10″ hole cut into it to match and line up with the 10″ opening of the exhaust pipe "E" which will permit the vapors to freely pass from the kiln into the exhaust system.

Step #2—We light a torch, turn on our bottled gas, which supplies the fuel for our ignition system within the "Combustion Chamber F." We light the pilot light in the chamber with the torch.

Step #3—We next remove the anti-pollution device or drum assembly from on top of the kiln.

Step #4—Wearing gloves, we carefully put the cap "D" securely over the flue pipe "C-1" opening, sealing this smoke and vapor exit. We place two 4 x 9 bricks on this cap "D" to make sure the cap is not blown off by internal pressure. Almost immediately the smoke and vapors previously emitted from the top of the kiln start up thru the smoke stack and exhaust system where the pilot light comes into action igniting the gases and smoke exiting into the combustion chamber "F." At the time of putting on the cap "D" during the switch-over, there is usually a small blow-out of smoke which puffs out of the open air intake ports. This is nothing to be alarmed about. However, make sure that the exhaust system is open before you put the cap on the kiln or the gas buildup in the kiln could cause a more severe kickback.

THIS IS THE REAL STARTING POINT FOR THE NORMAL CHARCOAL MAKING CYCLE.

Sometimes at this point, if the wood is not sufficiently dry there is a tendency for the heat in the kiln to drop in temperature for the first few hours after the "Switch-over." The damp wood also produces more steam vapor which exits thru the exhaust system in a white cloud. This steam vapor does not burn up because of the low heat being generated. This condition usually corrects itself after a few hours provided the wood is not overly wet.

The time to light the kiln and tend to its cooking adjustment periods depends on the operator's individual preference or timetable. I prefer to light my kiln early in the evening, taking advantage of daylight and at the same time being able to sleep during the first part of the normal charcoal cycle. The adjustments for oxygen input become more critical during the

last part of the cooking cycle. On the average most cooking periods take around 20 hours.

If you are fortunate enough to have small pieces of kiln dried scrap wood as raw material (I consider this the best), you will find that the batch will cook much faster, so that it would probably be advisable to start your batch in the early morning hours. The batch would most likely take from eight to 12 hours to cook.

Assuming that you are using chunk wood cut into 12″ pieces and split into 3″ wedges, the normal time sequence would go something like this:

Light kiln at 7 P.M., switch-over at 9 P.M. Adjust air ports at 11 P.M.—Go to bed. Set alarm for 2 A.M. (adjust air ports—10 minutes)—go back to bed, setting alarm for 5 or 6 A.M. (adjust air—10 minutes). From this point on adjust or check kiln hourly. By adjusting air, I mean test the air intake ports with a poker as mentioned earlier, noting whether or not the holes show red-hot. Whenever the holes are red-hot and little if any wood resistance is felt it is time to either partially close that particular hole or shut it off completely. As you close one hole you progressively open one of those that has not previously been opened. As mentioned in the first part of "Tending The Kiln" section, the four holes opposite the stack are opened first and as you close one hole you progressively open another trying to keep the closing and opening process evenly distributed on both sides of the kiln as you work toward the stack. The two holes next to the stack should be the last two holes opened and the last to be cooked. Back to the time sequence—After checking and adjusting the kiln at 5 or 6 A.M., you may find that the cooking time is advancing more rapidly. You may have to start checking the kiln every half hour or sooner. This also means that the kiln may be ready to shut off by 10 or 12 A.M.

Let us again assume that by 9 A.M. all holes except the last four (two on either side of the stack) have been judged properly cooked and have been closed off completely by affixing the pipe caps onto the air intake ports. The last four holes will probably cook out very rapidly (within an hour's time). Keep tabs on this by frequent use of the poker.

Oftentimes near the end of the cook, a roaring chimney stack fire will develop within the stack and combustion chamber. This again is nothing to be alarmed about. However, be careful not to get burned on the stack. And again near the end of the cook, the pilot may be blown out by updrafts. If in these instances you note very little if any smoke being emitted from the stack or if the smoke coming out is of a light blue color, this means that the charcoal cooking period has been completed. IT IS NOW TIME TO SHUT DOWN THE KILN COMPLETELY.

Do this by closing all remaining holes but one. Let this last hole be one of the holes in second position away from the stack. (That is to say let us assume that there are 14 air intake holes evenly spaced around the kiln.) Clockwise from the stack, #2 hole could be the last or on the other side of the stack, #13 could be last, the choice is yours. The purpose for leaving this one hole open longer is to bleed off the burning gas still being generated or remaining in the kiln. The number 2 or 13 position is also farther away from the stack and shut-off housing box. The next to last step is to close off the kiln shut-off system:

With gloves on, we now remove the plate "H-3" from the sand box housing "H." This plate has been in use or open all thru the cook. We carefully insert plate "H-2" in the slot from which "H-3" was just removed. The "Solid" plate "H-2" now in position will close out the open passageway from the kiln thru pipe "E."

You will note that the one open air intake port is now emitting gushing flames which should be allowed to subside before closing with a cap as the final step in the cooking process. After the last cap has been put on, the sand box housing "H" should be filled with sand to seal the kiln shut-off system.

COOLING PERIOD

After the cook, the kiln is sealed as described in the preceding paragraph and left without disturbing in any way, except to add sand where necessary if any leaks should develop. 24 to 30 hours is usually sufficient time for the kiln to cool so that all of the charcoal inside is stone cold. I usually check the kiln for any signs of heat early the following morning after a cook. If the kiln is cold at that time, it should be safe to open the kiln that same evening. If the kiln is warm on the outside to the touch, it should not be opened for another day.

OPENING THE KILN

Before opening, all sand should be removed from the top section gutter "B-2" and from the bottom section channel "A-3." If this is not done sand will probably drop into the charcoal as the top and middle sections of the kiln are lifted away.

Next the top section "C" should be hoisted out of the way with cap "D" still in place. At this point I usually take a quick peak into the kiln to see what kind of batch it appears to be. I also again test for warm charcoal or any hot spots, which may be very hard to spot because at this point all or most of the smoke and gases have been removed and nothing is visible to help you detect any hot spots. If the kiln is opened early in the morning before the sun has had a chance to warm the kiln, no heat should be felt radiating from the opened kiln. However, if the kiln is opened later in the day after the sun has been shining on it, the open kiln may exude some heat even though the

charcoal is not actively hot, which may cause some uneasiness before getting the charcoal into bags.

The middle section "B" is next hoisted away, followed by the removal of the fire cage "G" and the extension "G-1."

At this point, the first batch of charcoal may appear to be a strange looking pile of black, dusty material to the inexperienced operator. If he is expecting a kiln packed full of neat looking charcoal lumps, he will be sadly disappointed. In the process of converting to charcoal the wood will have shrunk until the remaining charcoal is about one fourth of the original wood volume. Weight-wise it will be even less.

In opening and dismantling the kiln the charcoal remaining will probably only fill the bottom section "A." Also, charcoal in the cooking process usually retains its original stick or board form unless it has been changed by dropping or impacting against other objects.

Before doing anything else, this operator usually takes a shovel and sharply strikes into the pile of unprocessed charcoal repeatedly to break up the original wood form into smaller pieces of charcoal. Once this is done the screening and bagging of the charcoal may begin.

SCREENING AND BAGGING

Charcoal is a very dusty product to process, and masks to filter out as much dust as possible should be worn by the operator, especially during the screening operation. I built my own screener, which I will not describe here. However, all of my raw product is broken down into small pieces by striking with a shovel as mentioned earlier. Once this has been done, the charcoal is shoveled onto my screener and passed over a 1/2" wire mesh and then into bags right from my screener.

In the last few years, I have found it most convenient and economical to package all of my charcoal in 20# bags. Bags purchased in small quantities are very hard to find and also very expensive. Large used bags from feed mills and used flour bags from bakeries are a source of sturdy three- and four-ply bags. The outer printed ply of these stitched bags may be carefully removed and any grain or flour residue easily shaken out of the bags leaving a clean, new looking bag onto which a gummed printed label may be attached.

STORAGE

Charcoal readily absorbs moisture, so the charcoal should be put in bags, weighed and tied as soon as possible after opening the kiln. Bags will also absorb moisture, so they should not be stored on cement floors. Lay them on building paper or wood material such as plywood.

The charcoal easily breaks down into smaller pieces or fines if handled too harshly; never toss the bags around. Rough handling of the bags of charcoal will sometimes cause holes to be punctured in the bags by some of the sharp edges of the charcoal.

SELLING CHARCOAL

You must be your own salesman when you first start to market charcoal. Once you have established a reputation for making "Top Quality Charcoal" the product sells itself. The word spreads rapidly and customers may flock to your place of business.

During this past year 1981, my charcoal, "NEWTON'S BLEND," has been selling for approximately 23¢ per pound. I have been unable to meet the demand for my product. I have sold all that I could make.

However, I wish to point out that since the energy crisis of the past few years there is much competition for wood. The cost is high and may be out of sight unless you cut your own wood, which I have done the last few years. Cutting your own wood, however, takes time away from charcoal making, drastically lowering your production, which means less sales and turning away disappointed charcoal purists who want nothing but **Good Lump Charcoal.**

OPERATING COSTS

The initial costs to get started in making charcoal may seem high to many individuals. Kiln costs, hoisting equipment, screening apparatus and other items needed in the charcoal operation can be very expensive. Cut costs by purchasing used equipment and build as many items that you can with your own labor or friendly help. However, there are no used kilns of my design on the market and they would have to be made of sheet metal and bar stock as described in previous sections of this booklet.

I built my latest kiln in 1978, at which time the materials and labor to construct the kiln cost approximately $2000.00. At today's inflated prices the cost could be doubled. There are shortcuts and less expensive ways to get the construction job done: Basically you have to have a sheet metal shop cut, bend and form most of the metal parts required. If you can weld or have a friend who will weld for you, you can cut costs substantially by fitting and welding the parts together yourself.

Keep in mind that with the design and solid construction of this kiln, it should have a minimum useful life of 20 years.

It is possible to make three (3) batches of charcoal a week using my kiln. On the average it takes 48 hours for one complete cooking and cooling cycle with 168 hours available in a week.

Assuming the kiln cost you $5000 to build and you took a depreciable life of 20 years for the kiln, the yearly cost would be only $250.00 to operate. This $250 cost spread over a cost-per-batch process would appear to be very inexpensive assuming you make 50-plus batches a year.

SUMMARY

My hobby of operating my self-designed small sheet metal kilns during the last 20 years has been a very satisfying experience.

I believe that I have developed a "Unit" that makes the "High Quality Lump Charcoal" that I set out to make 20 some years ago. It should have a long, usable life. It is simple to operate. It produces very satisfactory quantities when using top quality, properly prepared, dried hardwoods.

I wish to encourage any reader of this booklet who may have the desire and who feels qualified to venture into "Charcoal Making" as a hobby or small business venture. Before ~~omitting~~ yourself I suggest that you first ask yourself a few questions:

1. Do I mind doing hard, dirty work? (Charcoal is dusty.)
2. Is there an available supply of inexpensive good wood?
3. Will local and state laws permit the venture?
4. Is there a good nearby market (customers) to sell your product to?
5. Do I have the finances to properly equip myself?
6. Do I have property or an operating site on which charcoal can be made?

If your answers to the above questions are of a positive nature, then I hope that you will proceed and I wish you "Good Luck."

The descriptions and operating instructions in this booklet should be all that you will need to guide you onto the right path to making "Quality Lump Charcoal."