Sawdust Burning Space-Heater Stove

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INSTRUCTIONS & DRAWINGS

for building a:

SAWDUST BURNING

SPACE-HEATER STOVE

$2.00

METASTASIS
Post Office Box 128
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SAWDUST-BURNING STOVE AND SPACEHEATER

(Drawings & Assembly Instructions)

INTRODUCTION Using a surplus 55-gallon steel drum and one or several smaller ~~30~~ 15-gallon drums, and following the instructions below, you will be able to manufacture a reliable, long-burning (up to eight hours, depending upon type and condition of the sawdust fuel charge) stove that can be reloaded after burnout in a minute or two. The stove has the advantage of steady heat output (due to the uniform finely divided nature of the fuel) and almost 100% fuel usage (very little ash is left after burning). Some construction options to increase heating efficiency are included, as well as suggestions on how to use the stove as the basis for a forced-air heating system where the stove may be placed in a room apart from the area to be heated. Several alternative methods of construction are suggested which allow the builder to choose those techniques which fit his or her skills and budget. Sawdust is often the cheapest fuel around (perhaps it is burned for waste at a local mill and can be had for the hauling), and in any case sells for less than the equivalent amount of cord-wood.

MATERIALS LIST

1 - 55-gallon drum, with clamp-on type lid (STOVE BODY)

1 - ~~30~~ 15-gallon drum, with lid removed (FUEL CANNISTER)

1 - 22-3/8" diameter piece of 12 or 14 gauge steel (check dimensions against 55-gal drum to insure exact fit) (BOTTOM PLATE)

1 - 5½" x 9" piece of 12 or 14 gauge steel (CLEANOUT/DRAFT DOOR)

2 - 1" x 10" pieces of 14 or 16 gauge steel (DOOR SLIDE GUIDES)

2 - medium eyebolts with nuts and lockwashers (DOOR HANDLE & DRAFT

1 - 15" piece of light twist-link chain CONTROL ASSEMBLY)

1 - 30" x 3½" diameter wood post (CORE MANDREL)

1 - large screw eye (MANDREL HANDLE)

2 - adaptor rings or conversion collars for 6" stovepipe

2 - damper controls for 6" stovepipe

1 - 90° elbow fitting for 6" stovepipe

1 - Tee fitting of 6" stovepipe

Additional stovepipe to connect stove to chimney

Asbestos furnace cement as needed to seal cracks and joints.

Various stovebolts, nuts and washers as required if joints are to be bolted rather than welded. Also, four 4" angle braces will be needed if Bottom Plate is to be bolted in rather than welded.

CONSTRUCTION

We strongly recommend that wherever possible a welding torch be used for the construction of this stove. The result will be a more solid and lasting stove. However, recognizing that not everyone has access to welding equipment, suggestions for other means of construction have been included--a bolted together stove sealed with asbestos furnace cement (available at any hardware store) will result in a perfectly satisfactory heater. Moreover, a stove that has been bolted together may be disassembled and the critical parts may be transported in a small space, needing only the drums for rapid reassembly at another location. Also, since the outer Stove Body is not subject to the extreme heat of the burning sawdust (which is contained by the inner Fuel Cannister), the outer drum will last a long time even if not welded. A coat of heat-resistant paint (flat stove black or other color) will serve to spruce up the looks of the stove if its location requires a "finished" appearance.

Only four pieces of steel must be cut for this stove. Steel may be cut from new sheet stock, scrap or perhaps pieces from other drums may be used. Several holes must be cut in the steel pieces and in the drums. Cut the steel with a torch, saber saw with metal-cutting blade, close-quarters hack-saw or cold chisel, or have the work done at a local shop. The only other specialized tool that will be needed is an electric drill and assorted high-speed twist bits. (Especially if you plan to bolt the stove together, there will be a lot of drilling to be done.)

Stove Body: Choose a clean 55-gallon drum of the type in which grease is packed, the kind with a ring-clamp closure and removable lid. (Lacking this type of drum, you will have to use a standard bung-top drum. Scribe a line around the side of the drum one inch below the top rim weld. Cut off the top of the drum along this line. Using a heavy (ball-peen) hammer expand the one inch lip left on the drum top by pounding around it from the inside. File or grind the edges of the drum top smooth. Also smooth the rough edge left on the drum. You should now be able to fit the drum top down over the open drum end and form a smoke-tight seal.) Clean the drum thoroughly of all its former contents.

Cleanout/Draft Hole: Select where the Cleanout/Draft Hole and stovepipes will enter the Stove Body. Scribe a 4½" high x 8" long rectangle where the Hole will be, marking the bottom of this rectangle no closer than ¼" above the lower rim weld on the drum. Cut out this rectangle.

Cleanout/Draft Door: From a piece of steel cut a 5¼" high by 9" long rectangle, which will fit over the Cleanout/Draft Hole as a door. Bend the Door to follow the curve of the side of the Stove Body.

Door Slide Guides: From steel slightly thinner than that used for the Door (for ease of bending and forming), cut out two 1" x 10" Slide Guide pieces, and shape them as shown in the drawing. (This can be done by pounding on a hard surface, bending in a heavy bench vise, or by use of a shop metal brake.) Alternatively, you may find already formed scrap or metal moldings that will work just as well. Hold the Door and Slide Guides against the drum to insure that the Door will slide easily. It is very important to align carefully the two Guides vertically so that the Door will move straight up and down. Spot weld the Guides into place, being sure that the Door is set into place before attaching the second Guide, as the Door cannot be removed because of the bump running around the drum

just above the top end of the Guides. (If you do not weld the Guides into place, center-punch and drill holes for stovebolts, nuts & washers.)

Door Handle: At the bottom center of the Cleanout/Draft Door drill a hole for a medium-size eyebolt, making sure that the nuts used to secure the eyebolt to the Door will not interfere with lowering the Door all the way down (ie, nuts should be about ¼" above the bottom edge of the Door.) Attach the eyebolt with nuts and lockwashers, inserting the last link of a 15" piece of chain on the eyebolt before tightening on the nuts. The eyebolt will serve as a Handle for the Door.

Draft Control: Directly above the position of the eyebolt Handle and above the lower reinforcing bump running around the drum attach a second medium eyebolt with nuts and lockwashers. Using pliers open this eyebolt so that a link of the chain may be hooked over it. The chain and eyebolt system controls the height of the opening below the Cleanout/Draft Door and thus controls the amount of air reaching the fire.

Stovepipe & Damper Fittings: Locate the exact position of the two stovepipe holes (one directly above the other) by fitting together a 6" "Tee" and Elbow and checking to see where the holes in the drum should be to line up with these fittings. Don't locate the stovepipe where it will enter the Stove Body too close to the upper bump running around the drum, or you will have complex fitting and sealing problems. You may attach the stovepipe fittings to the Stove Body in any number of ways. The easiest way is to use two manufactured cast-iron adaptor rings (also called oil-drum conversion collars) which bolt or weld onto the curved surface of the drum and provide a 6" hole for the stovepipe to be set into. Another method is to have someone handy at welding attach 6" diameter rings of heavy gauge steel at the correct locations on the side of the drum. Or, have a sheet metal shop fabricate a galvanized light metal collar assembly that will connect the drum and stovepipe together. Lastly, you can simply cut two 6" diameter holes in the drum where needed, insert a short section of stovepipe in each, and cut tabs in the stovepipe to fold out and crimp over the edge of the holes in the drum. Caulk it all over with asbestos furnace cement to close any holes that make cause leaks. Insert two manufactured damper controls in the stovepipe or fittings where they leave the Stove Body (each hole should be controlled by a damper).

Bottom Plate: Cut one circular plate out of heavy gauge steel to fit exactly the inside diameter of the 55-gallon drum. This may be 22-3/8" in diameter, but drums differ in measurement, so check! Cut a 2½" diameter hole in the exact center of the Plate. The Bottom Plate serves to divide the 55-gallon drum Stove Body into two chambers--the upper Smoke Chamber and the lower Cleanout Chamber. Weld the Plate across inside the drum 5¼" from the bottom (measured from the inside). (If you are not welding, attach four 4" steel angle braces at equal spacing around the Bottom Plate with stovebolts, nuts and lockwashers. Bolt the other legs of the braces to the sides of the Stove Body so as to create the 5¼" high Cleanout Chamber. Caulk or paste over the crack around the circumference of the Plate with asbestos furnace cement.) In use, one or more supports (bricks, short sections of pipe, etc.) set between the Bottom Plate and the true bottom of the drum to take the weight of the loaded Fuel Cannisters, yet out of the way for raking ashes out the Cleanout/Draft Door, will lessen the stress on the weld or angle braces and prevent the Bottom Plate from sagging over time.

Fuel Cannister(s): Either use a ~~30~~-gallon drum that came packed with grease (ie, removable crimp-on lid type) or the other bung-top kind. In either case the top or lid is removed and not used. Cut a 2½" diameter hole in the exact center of the bottom of the Fuel Cannister.

Core Mandrel: Take a 30" long post or 4x4 and using a drawknife, spokeshave or plane (or turning in a lathe) reduce the dimensions to a long, smooth taper 3½" in diameter at the top and 2-3/8" at the bottom. Insert a big screw-eye in the center of the top or wide end for a handle. Coat the Core Mandrel with a smooth hard finish (shellac, wax, plastic) so that the sawdust does not cling to it when used to prepare the fuel charges.

CHOICE OF FUEL

Practically any type of sawdust may be used in the stove. You can expect that sawdust from woods that burn well in a standard wood-burning stove will also serve well in this stove. Thus, hardwoods will be a better choice than softwoods which will deposit pitch and resins in the stove and stovepipes. The sawdust MUST be dry to burn well. If you live in a rainy climate you will have to obtain sawdust from inside mill buildings where aged wood is cut. An alternative is to use dry summer days to dry your sawdust before stashing it away for the winter in a covered bin. (Spread a large tarpaulin on the ground in the full sun and shovel or rake a thin layer of sawdust onto it. An hour or two later shovel it into your bin or into sacks for storage and repeat the process with new wet sawdust. Sawdust should be of uniform consistency throughout--inclusions of grass, rocks, sticks, large shavings and pieces of wood will make the tamping job more difficult and prevent even burning. You may want to sift the sawdust through hardware cloth before use. Build bins in the corner of your garage, barn or woodshed to store bulk sawdust--one for wet sawdust from the mill and another for dry sawdust. Another method is to store all the sawdust in burlap or paper feed sacks, which also makes for easier handling in some respects. Once dried, keep it dry.

CHARGING

Take an empty Fuel Cannister to the location of your dry sawdust storage bin. Set the Cannister upright (open top up) and insert the Core Mandrel into the hole in the center of the bottom of the Cannister. Holding the Mandrel so that it doesn't tip to either side but remains vertical at all times, pour about 4" of sawdust around it in the bottom of the Cannister. Using another post, 2x4 or other weighty object tamp the sawdust FIRM. Add another few inches of sawdust and again tamp firmly all around the central Mandrel. (Shortly the well-packed sawdust will act to hold the Mandrel upright, so you won't have to hold it as you pour more additions of sawdust into the Cannister.) Continue to fill and tamp until the Fuel Cannister is full to the brim.

Leaving the Mandrel in place to avoid jarring or dislodging the hard-packed sawdust, lift the packed Cannister into the Stove Body, being careful to place the Cannister in the exact center of the larger drum (thus aligning the central holes in the Cannister and Bottom Plate). Carefully remove the Core Mandrel straight up and out of the Fuel Cannister (a slight twisting motion helps). Be sure not to bump into the sides of the sawdust fuel charge, which should remain now with a cylindrical hole (the core) all the way from the top of the Cannister to the bottom and directly over the aligned bottom holes.

One other or several Fuel Cannisters may be packed in advance at your sawdust bin and carried to a spot near the stove (with a Mandrel in place to prevent inadvertant collapse of the core through the sawdust), to be placed into the stove when needed.

BURNING

Before attempting to light the stove, make sure that the Cleanout/Draft Door and the upper damper control are full open to allow for maximum oxygen supply for the fire.

To start the sawdust burning crumple a sheet of dry newspaper into a ball. Follow either of two procedures to light the stove: (1) Touch a match to the newspaper and drop it into the top of the core through the sawdust and let it fall to near the bottom of the Cannister, or (2) drop the newspaper ball into the core, let it fall to the bottom, and reach in through the Cleanout/Draft Door to light it with a match. Sometimes you will find that a long twisted page of newspaper works better than a ball in making the core-lining sawdust catch fire. Either way, once the sawdust has been ignited cover the top of the Stove Body with the Lid. Smoke may leak out around the edge of the lid until the fire begins to draw. If you continue to have smoke leaks fit the Lid on tighter, perhaps using the ring-clamp that came with the drum.

After establishing a draft and the fire is burning well with the upper damper open, open the lower damper and close the upper one. This will force smoke and heated air to circulate lower in the Smoke Chamber around the Fuel Cannister before exiting up the chimney. The Stove Body will then heat up over more of its surface and be a more efficent radiator.

Control the speed of burning by adjusting the draft and damper openings--lots of air for a quick hot fire, less for a longer-burning cooler one.

The sawdust begins burning all along the inside surface of the core and burns outwardly (radially). Ignition is usually quite thorough with properly dried and evenly tamped fuel--what little ash there is falls mostly through the hole in the bottom of the Fuel Cannister onto the floor of the Cleanout Chamber. Depending upon your sawdust quality (particle size, wood type, moisture, etc.) you may get more or less ash. If there is a lot, you might first try to tamp the Cannisters more firmly to insure that burning particles don't easily dislodge and fall into the Cleanout Chamber only partially consumed. If the fire seems to be dying for lack of air even with the Draft Door open, use a metal poker to push ash out of the way. This ash must be removed periodically to prevent chronic blocking of air flow. Use a home-made hoe or ash rake to pull the ash out through the Cleanout Door.

OPTIONS

Several design changes or additions can increase the stove's efficiency.

Quick Recharging: Make up several Fuel Cannisters (extra Core Mandrels are needed too) and pre-pack them with sawdust. As your fire dies from lack of fuel in the Cannister in the stove, remove the top Lid of the stove with heavy gloves to prevent getting burned, lift out the empty Cannister, and replace it with a full one. Remove the Mandrel, light as previously, and you have heat again.

Internal Baffles: Afix sheet metal baffles inside the main 55-gallon drum around the Fuel Cannister position. These baffles can direct the

flow of smoke and hot air around the Stove Body, which will allow more heat to radiate into the room.

Radiation Fins: Weld or bolt on steel angle, "I" or other formed stock every three or four inches vertically around the outside of the Stove Body. This provides more heat radiating surface--less heat goes up the chimney and more is left in the room.

Stovepipe Radiator: Add additional stovepipe inside the room to be heated by piecing stovepipe and fittings together for increased heat radiation inside. We've seen some crazy-looking configurations that crammed many feet of stovepipe in the short distance between the stove and chimney all for the sake of better heating. Just make sure that your draft isn't slowed by extreme dips in the stovepipe that force the heated air to travel downward.

Forced Air System: Use the Radiating Fin improvement to maximize the surface area of the stove. Then construct around the Stove Body an enclosed Hot-Air Chamber of sheet metal. The Hot-Air Chamber may be of a rectangular or box shape or that of another cylinder around the Stove Body. Only light-weight galvanized metal will be necessary for this Chamber. Note in the sketch that the Cleanout/Draft Door must remain accessible to the outside air, and that no connection should be made between the Hot-Air Chamber and the inner Smoke Chamber or the stovepipes. Air forced into the Hot-Air Chamber by a fan (or sucked out by a fan at the other side) can be ducted and directed to other rooms or buildings to be heated. Be sure the cool air supply enters near the bottom of the Hot-Air Chamber and the heated air ducts leave near the top. The efficiency of this design can be improved by extensive baffling attached inside the Hot-Air Chamber so that air is kept in proximity to the Stove Body for as long as possible. The top of the Hot-Air Chamber must be able to be opened to allow replacement of Fuel Cannisters in the stove.

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If you have any questions, suggestions for improvements to be incorporated into the next printing, best wishes, etc., please write. If you have trouble obtaining any manufactured parts or fittings we will be able to supply them at reasonable prices. Good luck!

METASTASIS
Post Office Box 128
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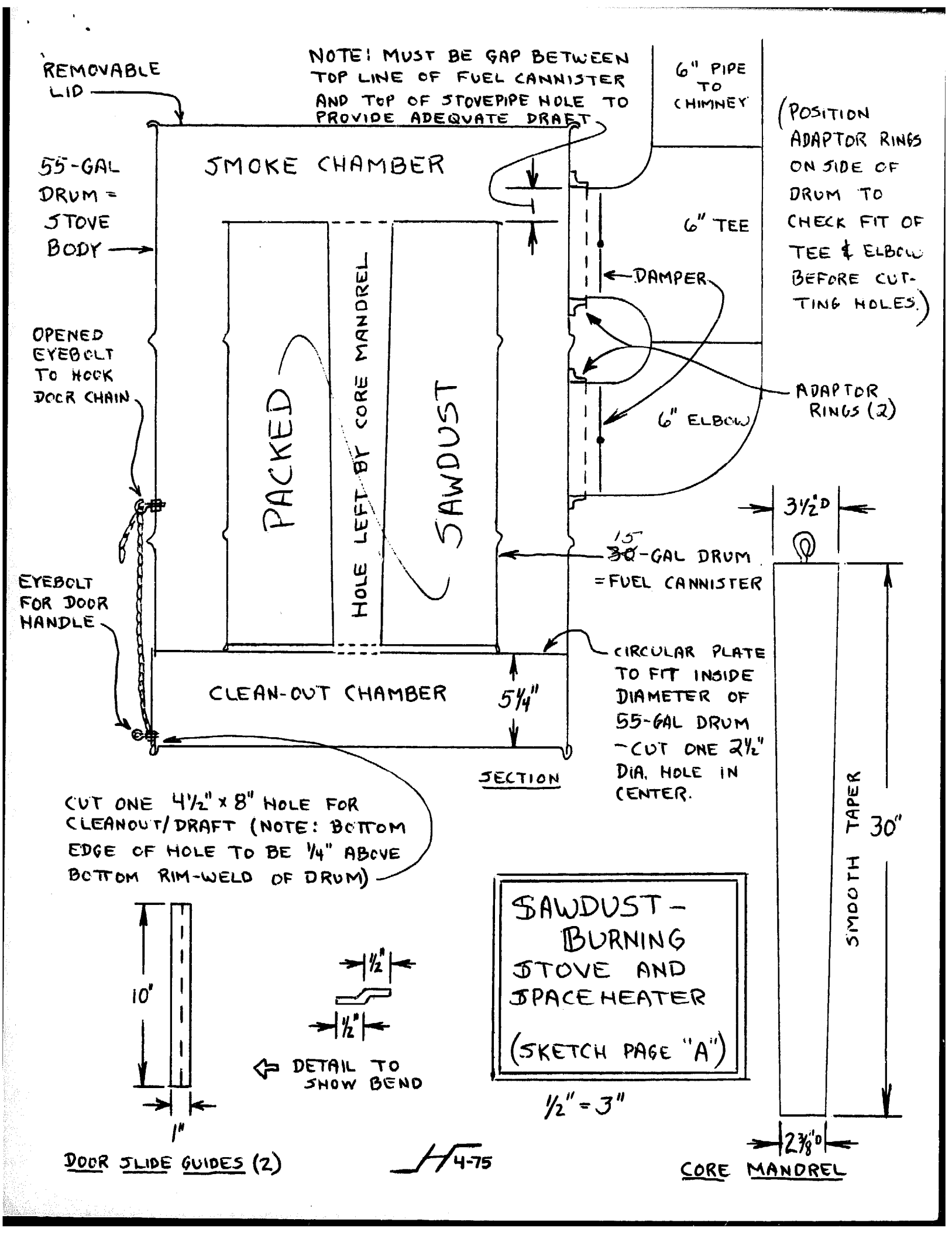
First Printing
5/75

About Fuel Cannister Sizes:

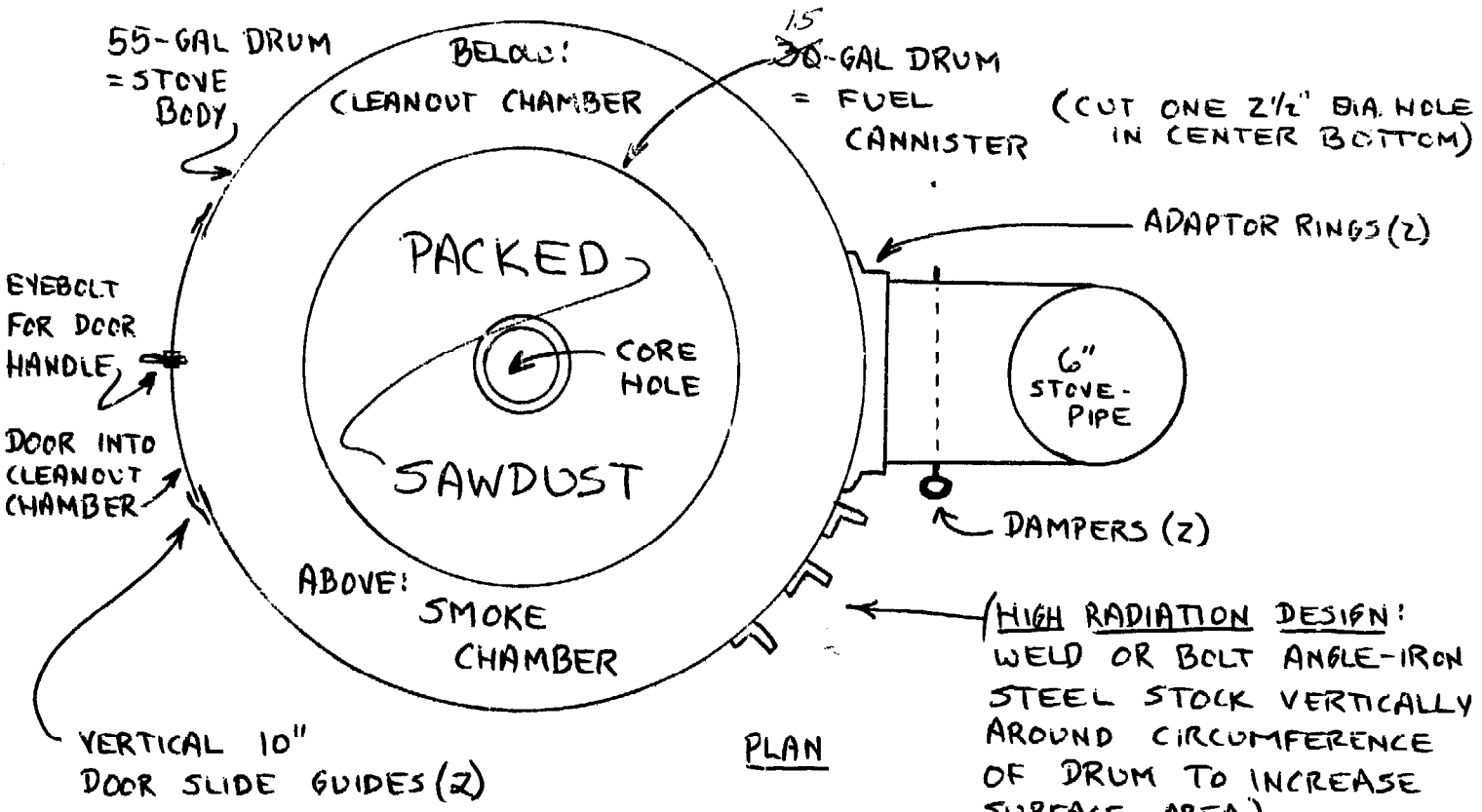
You can use either a 30-gallon or a 15-gallon drum for a Fuel Cannister. The 15-gallon drum is much more commonly found, and the dimensions in the plans and scale drawings apply to a 15-gallon Cannister. If you come across a 30-gallon drum you will have to adapt the plans according to the larger size of this drum. The Bottom Plate will have to be mounted lower in the 55-gallon Stove Body, making the Cleanout Chamber smaller. The Cleanout/Draft Door must then be proportionally lower to fit the Chamber. (Raking ashes out will be a little harder.) The stovepipe Tee should enter the Stove Body as close to the Lid as possible, to allow for maximum draft flow across the top of the higher Cannister into the stovepipe. The 30-gallon drum will burn twice as long as the 15-gallon one. (Note: You can make a smaller version of the stove with a 30-gallon Stove Body & a 15-gallon Fuel Cannister.)

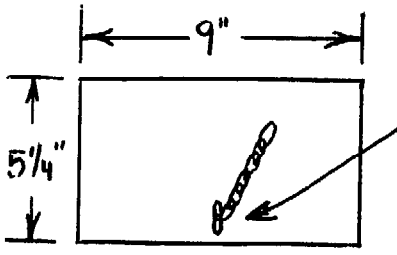

REMOVABLE LID
NOTE! MUST BE GAP BETWEEN TOP LINE OF FUEL CANNISTER AND TOP OF STOVEPIPE HOLE TO PROVIDE ADEQUATE DRAFT
6" PIPE TO CHIMNEY
(POSITION ADAPTOR RINGS ON SIDE OF DRUM TO CHECK FIT OF TEE & ELBOW BEFORE CUTTING HOLES.)
SMOKE CHAMBER
55-GAL DRUM = STOVE BODY
6" TEE
DAMPER
OPENED EYEBOLT TO HOOK DOOR CHAIN
PACKED
HOLE LEFT BY CORE MANDREL
SAWDUST
ADAPTOR RINGS (2)
6" ELBOW
3½"D
15 ~~30~~-GAL DRUM = FUEL CANNISTER
EYEBOLT FOR DOOR HANDLE
CIRCULAR PLATE TO FIT INSIDE DIAMETER OF 55-GAL DRUM - CUT ONE 2½" DIA. HOLE IN CENTER.
CLEAN-OUT CHAMBER
5¼"
SECTION
CUT ONE 4½" x 8" HOLE FOR CLEANOUT/DRAFT (NOTE: BOTTOM EDGE OF HOLE TO BE ¼" ABOVE BOTTOM RIM-WELD OF DRUM)
SMOOTH TAPER
30"
SAWDUST-BURNING STOVE AND SPACE HEATER
(SKETCH PAGE "A")
½" = 3"
10"
1"
DOOR SLIDE GUIDES (2)
½"
½"
DETAIL TO SHOW BEND
4-75
2⅜"D
CORE MANDREL

SAWDUST-BURNING STOVE AND SPACEHEATER "B"

1/2" = 3"

H 4-75





CLEANOUT/DRAFT DOOR

(BEND DOOR TO FIT CURVE OF STOVE BODY)